STAR

0038841
133

DOE/RL-93-46
Draft B

RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-DR-2 Operable Unit, Hanford Site, Richland, Washington

9413296.161

Date Published
June 1994

United States
Department of Energy
P.O. Box 550
Richland, Washington 99352

Approved for Public Release

THIS PAGE INTENTIONALLY
LEFT BLANK

THIS PAGE INTENTIONALLY
LEFT BLANK

EXECUTIVE SUMMARY

INTRODUCTION

This work plan establishes the operable unit setting and the objectives, approach, tasks, and schedule for conducting the Resource Conservation Recovery Act (RCRA) facility investigation/corrective measure study (RFI/CMS) for the 100-DR-2 Operable Unit in the 100 Area of the Hanford Site. This work plan is intended to cover the entire RFI/CMS program, but it is focused on limited field investigation (LFI) activities. The 100 Area is one of four areas at the Hanford Site that are on the U.S. Environmental Protection Agency's (EPA) National Priorities List (NPL) under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA).

~~The 100-DR-2 Operable Unit is one of three source operable units in the 100-D/DR Area (Figure ES-1). Source operable units are those that contain facilities and unplanned release sites that are potential sources of hazardous substance contamination.~~

The 100-DR-2 Operable Unit is one of two source operable units in the 100 D/DR Area (Figure ES-1). Originally, there were three source operable units in the 100 D/DR Area, however, the 100-DR-3 Source Operable Unit has been incorporated into the 100-DR-2 Operable Unit. Source operable units are those that contain facilities and unplanned release sites that are potential sources of hazardous substance contamination.

All work conducted under this work plan will conform to the conditions set forth in the *Hanford Federal Facility Agreement and Consent Order*, (Ecology et al. 1990a), and its amendments, signed by the Washington State Department of Ecology (Ecology), the EPA, and the U.S Department of Energy (DOE).

The approach described in this work plan is based on the *Hanford Past-Practice Strategy* (DOE-RL 1991a). This strategy streamlines the past-practice remedial action process with a bias for action through optimizing the use of interim actions. This approach culminates with decisions of final remedies on both an operable unit and 100 Area scale. The strategy focuses on reaching early decisions (interim remedial measures [IRM]) to initiate and complete cleanup projects, maximizing the use of existing data (historical and analogous facilities), coupled with focused short time-frame LFI where necessary.

The RFI/CMS process for the 100-DR-2 Operable Unit follows the path detailed in Figure ES-2. The work scope described in the work plan is a result of the scoping process which involved Ecology, EPA, and DOE. The pathway selected during the scoping process for the high-priority liquid waste sites and solid waste burial grounds in the 100-DR-2 Operable Unit is the IRM pathway. Other sites (low-priority sites) will be deferred and will follow the regular RFI pathway. It should be noted that the diagram shown in Figure ES-2 is included in this work plan to illustrate the normal procedure for getting from initial scoping of the operable unit to implementation of a remedial action. However, when opportunities come about to accomplish these tasks more efficiently, the Tri-Parties do what they can to recognize those opportunities and to act on them.

OVERVIEW

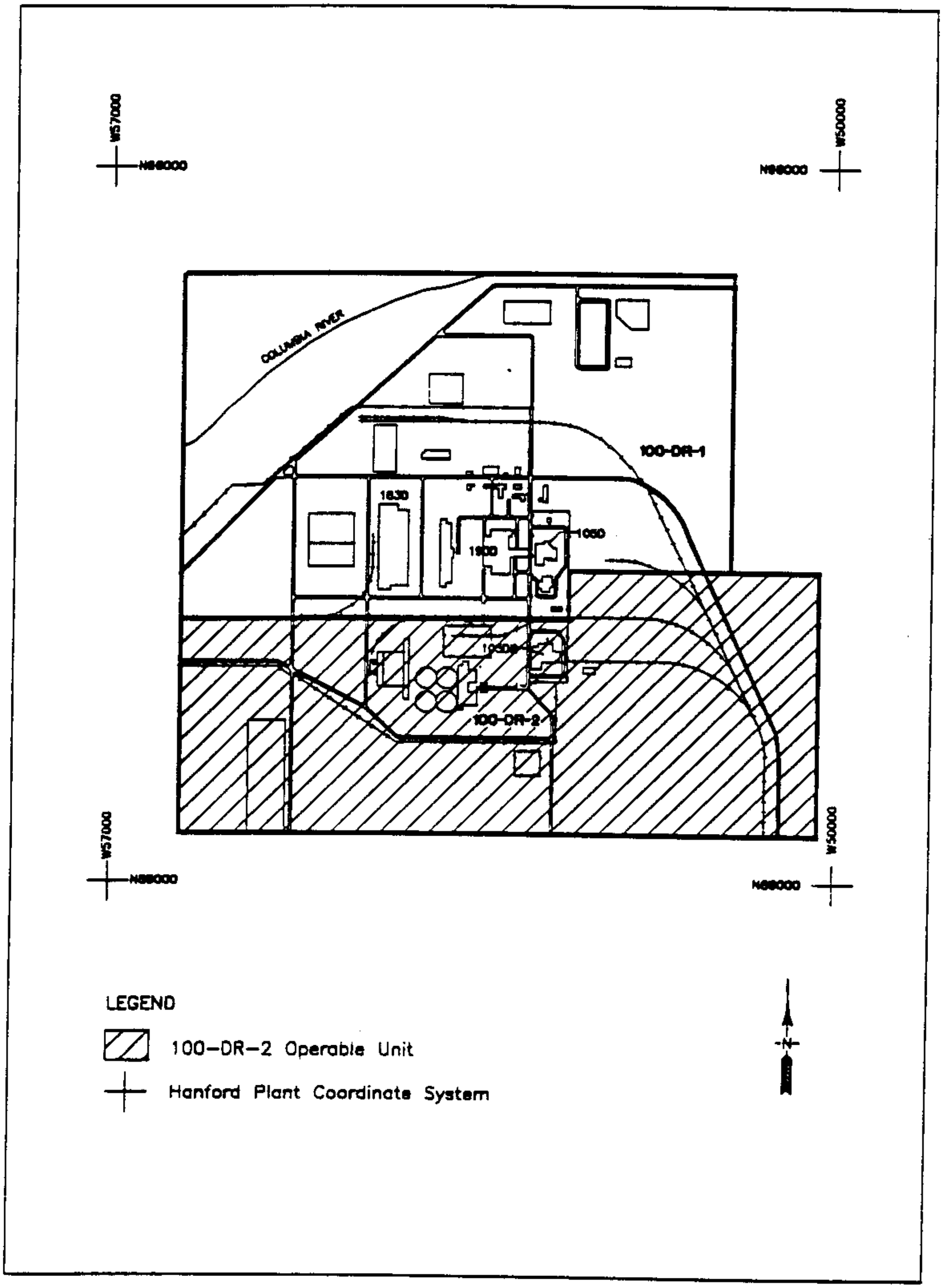
The investigative approaches to waste sites associated with the 100-DR-2 Operable Unit are listed in Table ES-1. Tables ES-1 and 2-1 also provide summary discussions, and the rationale for investigations of the high-priority sites, solid waste sites and low-priority sites. The waste sites fall into three general categories: high-priority liquid waste disposal sites, low-priority waste disposal sites, and solid waste burial grounds. Several sites have been identified as candidates for conducting an IRM. Three sites have been identified as warranting additional field sampling. These sites are the 116-DR-3 Storage Basin Trench, the 116-DR-7 Inkwell Crib, and the Sodium Dichromate/Acid Pumping Station. All sites will continue to be evaluated through the RFI, even if they do not require an IRM.

The limited field sampling will consist of one borehole at the 116-DR-7 site and test pit excavations at the 116-DR-3 and Sodium Dichromate Tanker Car Off-Loading sites. Figure ES-3 shows waste site locations in the 100-DR-2 Operable Unit. Figures ES-4 and ES-5 show the proposed sampling sites. Sampling will take place where field screening instruments detect contamination. Samples collected will be analyzed for chemical and radiological constituents. The data quality objective process identified the Ecology, EPA, or DOE and technical lead agencies as the primary data users. The primary data uses are: (1) determination of maximum contaminant concentration to support a qualitative risk assessment; (2) define vertical distribution of contaminants; and (3) determine if and when an IRM action is necessary.

A report will be prepared upon completion of the LFI. The report will include the results of source investigations, historical investigations, process knowledge, field screening, and geophysical surveys; identify the nature and vertical extent of contamination at the high-priority liquid waste sites; identify the contaminant- and location-specific applicable or relevant and appropriate requirements; and provide a summary of the qualitative risk assessment performed for each of the high-priority sites. The report will include an assessment of whether thresholds are exceeded that warrant action through IRM. The LFI report will also evaluate sites analogous to those in the 100-DR-2 Operable Unit to aid in the determination of the need for an IRM. The LFI report will support the focused feasibility study (FS), which will address remediation options for the waste sites. Investigation of the 100-DR-2 Operable Unit has been initiated prior to public review of the work plan. It is anticipated that the results of the LFI will be available at the end of this review period and will be added to the work plan prior to it's final release. Should the scope of work proposed in this work plan be changed as a result of public review, it will be addressed at that time.

The FS process for the 100 Area will be conducted on both an aggregate area and operable unit basis. This process includes preparation of a 100 Area FS, a focused FS, and a final FS. Figure ES-2 displays how the entire RFI/CMS process culminates in the implementation of remedial actions for the operable unit. (It should be noted that the 100 Area FS has been prepared.)

Figure ES-1 100 D/DR Operable Units



THIS PAGE INTENTIONALLY
LEFT BLANK

9413296.1616

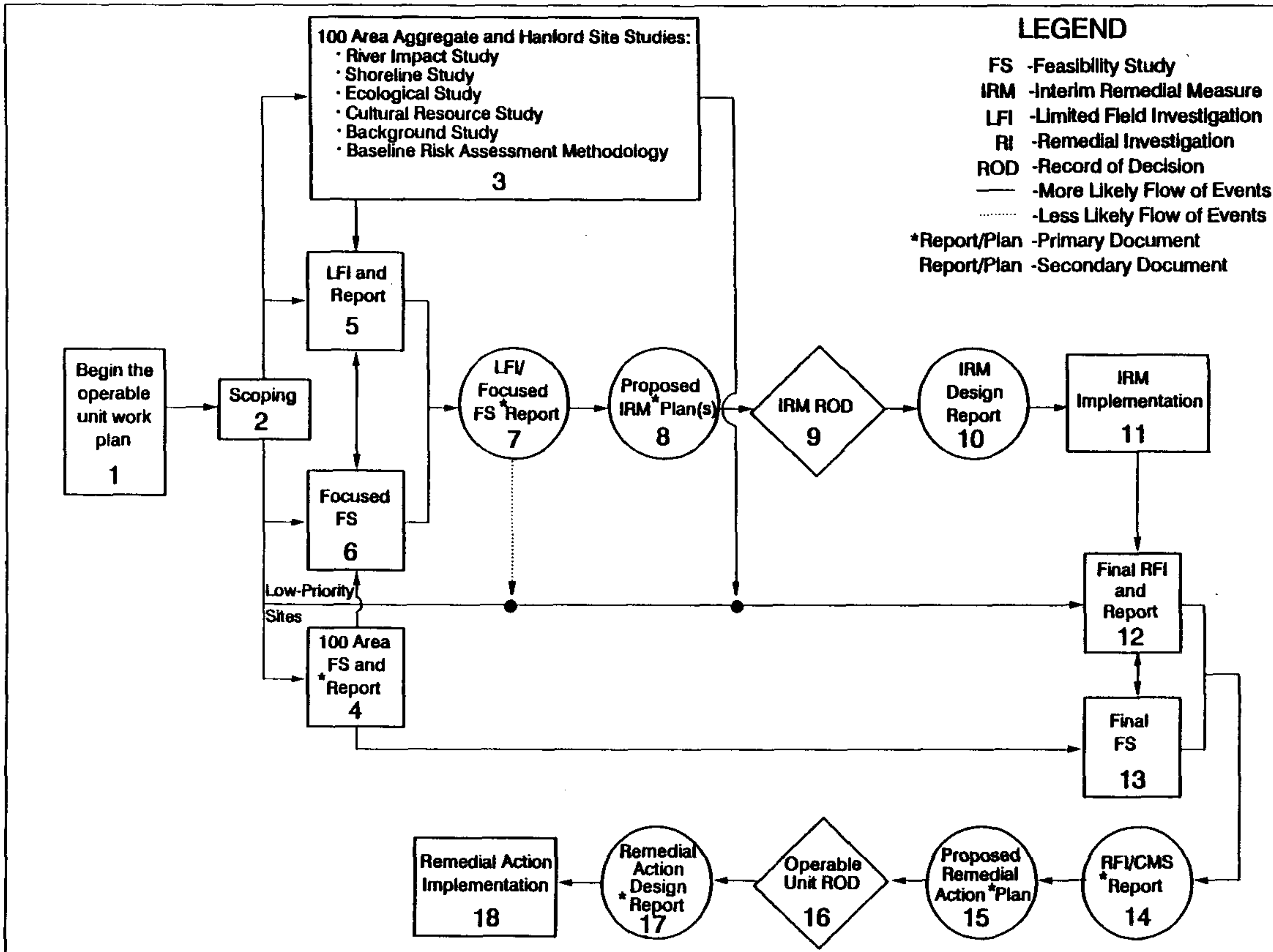
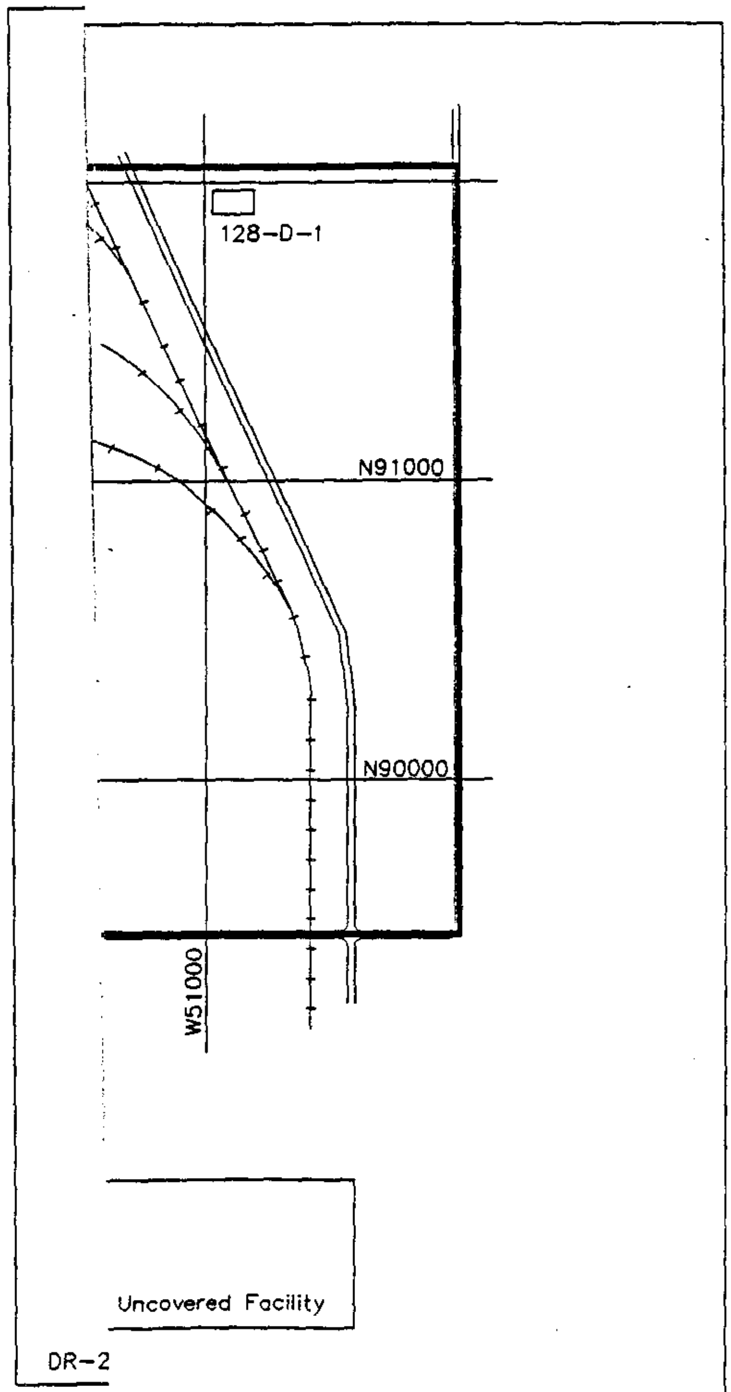


Figure ES-2 RFI/CMS Process for the 100-DR-2 Operable Unit

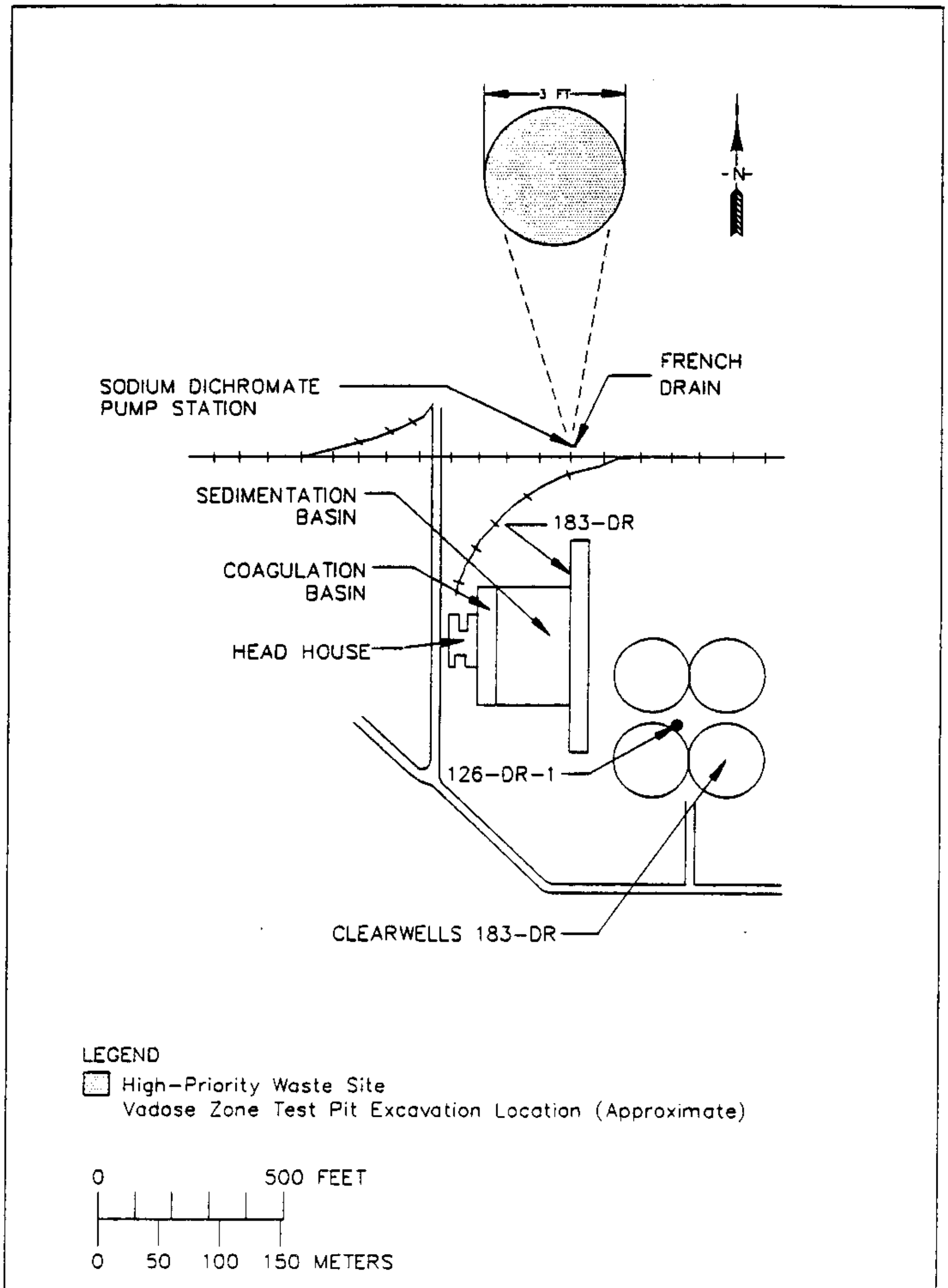
THIS PAGE INTENTIONALLY
LEFT BLANK

Figure ES-3 Waste Site Locations in the 100-DR-2 Operable Unit



THIS PAGE INTENTIONALLY
LEFT BLANK

Figure ES-4 Proposed Sampling Sites for the 100-DR-2 Operable Unit



THIS PAGE INTENTIONALLY
LEFT BLANK

9413296.1619

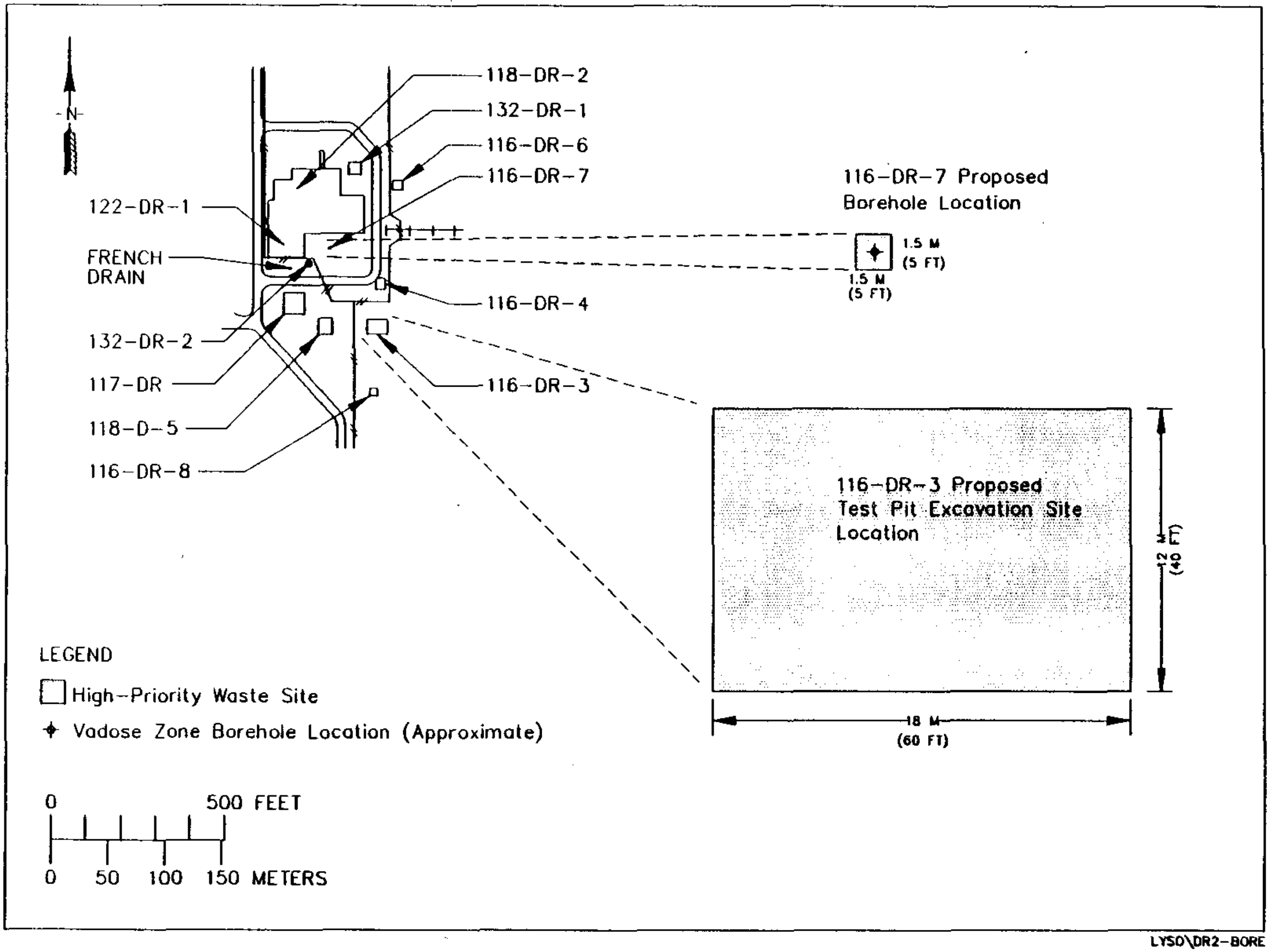


Figure ES-5 Proposed Sampling Sites for the 100-DR-2 Operable Unit

THIS PAGE INTENTIONALLY
LEFT BLANK

Table ES-1 100-DR-2 Investigation (Page 1 of 6)

Site (Alias)	Comments	Investigation Approach	Pathway/Boreholes (Test Pit)	Rationale
		High Priority Sites		
116-DR-3 (105-DR Storage Basin Trench)	This site was active during 1955, received 4,000,000 L of contaminated sludge and water from the 105-DR Fuel Storage Basin.	Geophysical survey using GPR of EMI to ascertain the presence and nature of materials used to fill the trench. One vadose zone test pit in a location determined by the geophysical survey.	LFI-IRM/1	This site has an HRS score of 40.09 and is considered a high-priority site. Previous sampling revealed the presence of radionuclide contamination at this site.
116-DR-4 (105-DR Pluto Crib)	116-DR-4 was active from 1952-1953, and received 4,000 L of liquid wastes from isolated tubes containing ruptured fuel elements in the 105-DR Fuel Storage Basin.	No LFI activity is planned for this facility as it is analogous to 116-D-2A.	IRM/0	This site has an HRS score of 9.13. The constituents present should be the same as those for 116-D-2A and thus the cleanup will use the results of 116-D-2A to define a remedial action.
116-DR-6 (1608-DR Liquid Disposal Trench)	The site was active from 1953-1965, received 7,000,000 L of diverted coolant during the Ball 3X upgrade. It also received diverted water during reactor shutdown.	LFI will be limited to currently locating the trench. This site is analogous to 116-DR-1 and 116-DR-2.	LFI-IRM/0	This site has an HRS score of 42.32. The constituents present should be the same as those for 116-DR-1 and 116-DR-2 and thus the cleanup will use the results of 116-DR-1 and 116-DR-2 to define a remedial action.

Table ES-1 100-DR-2 Investigation (Page 2 of 6)

Site (Alias)	Comments	Investigation Approach	Pathway/Boreholes (Test Pit)	Rationale
High Priority Sites (cont)				
116-DR-7 (105-DR Inkwell Crib)	The site was active during 1953, received 4,000 L of liquid potassium borate from the 3X System prior to the Ball 3X System upgrade. There is reason to believe the site may be a storage tank rather than a crib.	LFI should consist of geophysical surveys to determine if the facility is a crib or a storage tank. If surveys indicate it is a crib then a single borehole should be drilled to characterize the crib.	LFI-IRM/1	This site has an HRS score of 28.96. The waste received at this site came from the 3X System prior to the Ball 3X System upgrade.
116-DR-8 (117-DR Crib)	The site was active from 1960-1964, received 240,000 L of drainage from the containment system 117 Building Seal Pits. From 1972-1986, supported the 105-DR Sodium Fire Facility.	Research/identify waste(s) that were placed in crib. Determine if wastes exhibit extraordinary contamination problems; should this be the case, further field investigations will be implemented.	LFI-IRM/0	This site has an HRS score of 0.0. Data determined during research will determine if field investigations are necessary.
116-D-8 (100-D Cask Storage Pad)	Active from 1946-1975. Facility has 2 drainage systems; one for storm water and one for spillage. Spillage was handled by disposal through a french drain. The storage pad was decontaminated by removing portions of the concrete. The concrete chips were reported disposed of in the 200 Areas. Rinse water was disposed of adjacent to the pad in an area currently marked "Underground Radioactive Material."	Identify number and volume of spills that occurred on the pad. Site to include adjacent site posted as underground rad. Geophysics will be used to aid in location of french drain and evaluation of site.	IRM/0	The waste at this site is a result of leaks and spills that occurred on the pad. The site has already undergone a partial cleanup.

Table ES-1 100-DR-2 Investigation (Page 3 of 6)

Site (Alias)	Comments	Investigation Approach	Pathway/Boreholes (Test Pit)	Rationale
High Priority Sites (cont)				
132-DR-1 (1608-DR Waste Water Pumping Station)	The site was active from 1950-1964, received low level liquid waste. Unit consisted of an above ground structure and a below grade structure.	Research WIDS specific files to determine if any leaks occurred at this facility; if leaks occurred, determine volume, number, etc.	LFI-IRM/0	This site has been decommissioned.
Sodium Dichromate Tanker Car Off-Loading Facility	Possibly a source of contamination. Located north of the railroad tracks on the northern boundary of the operable unit.	Vadose zone test pit to ascertain the distribution and quantity of sodium dichromate in the vadose zone.	LFI-IRM/1	This is a significant waste site because undiluted volumes of sodium dichromate and acid solutions were disposed directly to the soil column.
Solid Waste Burial Grounds				
118-DR-1 (105-DR Gas Loop Burial Ground)	Site was active from 1963 to 1964, and received irradiated metal assemblies from the 105-DR gas loop. There is an estimated 20 m^3 of metallic waste buried at the site.	Locate using geophysical methods.	LFI-IRM/0	The potential for solid waste to migrate is very small.
118-D-1 (100-D Burial Ground No. 1)	Site was active from 1944 to 1967, received 10,000 m^3 of irradiated reactor parts, dummies, thimbles, rods, gun barrels and other contaminated solid waste.	Locate using geophysical methods.	LFI-IRM/0	The potential for solid waste to migrate is very small.

9413296.1623

Table ES-1 100-DR-2 Investigation (Page 4 of 6)

Site (Alias)	Comments	Investigation Approach	Pathway/Boreholes (Test Pit)	Rationale
Solid Waste Burial Grounds (cont)				
118-D-2 (100-D Burial Ground No. 2)	Site was active from 1949 to 1970, received approximately 10,000 m^3 of miscellaneous contaminated solid waste, irradiated dummies, splines, rods, thimbles, and gun barrels, and low-level radioactive solid waste from the 100 N Area.	Locate using geophysical methods.	LFI-IRM/0	The potential for solid waste to migrate is very small.
118-D-3 (100-D Burial Ground No. 3)	Site was active from 1956 to 1973, and received an estimated 100 m^3 of miscellaneous contaminated solid waste and irradiated dummies, splines, rods, thimbles, and gun barrels. It was also used for disposal of 100 N solid wastes.	Locate using geophysical methods.	LFI-IRM/0	The potential for solid waste to migrate is very small.
118-D-4 (Construction Burial Ground)	Site was active from 1953 to 1967, received contaminated material (mainly reactor components and hardware) generated during various reactor modifications from the 105-D Reactor Building.	Locate using geophysical methods.	LFI-IRM/0	The potential for solid waste to migrate is very small.
118-D-5 (Ball 3X Burial Ground)	Site was active during 1954, received 10 m^3 of thimbles removed from the 105-DR Reactor during Ball 3X work.	Locate using geophysical methods.	LFI-IRM/0	The potential for solid waste to migrate is very small.

Table ES-1 100-DR-2 Investigation (Page 5 of 6)

Site (Alias)	Comments	Investigation Approach	Pathway/Boreholes (Test Pit)	Rationale
Solid Waste Burial Grounds (cont)				
126-DR-1 (190-DR Clearwell Tank Pit)	This site has been active since 1970's as a landfill. The waste is nonhazardous, nonradioactive. The unit is an excavated area between 183-DR and 190-DR. Approximately 25% of the bottom surface contains a layer of waste 1.5 to 3.0 m deep that is covered with backfill.	Research and determine if "recent" disposal activities have occurred, if so, volumes, period of time, etc. The site will not be included in work plan if active status.	Defer/0	The potential for solid waste to migrate is very small.
128-D-1 (100-D/DR Burning Pit)	Site was active from 1944 to 1967, and was used for the disposal of an estimated 40,000 m^3 of nonradioactive combustible materials such as paint waste, office waste, and chemical solvents.	Locate using geophysical methods.	LFI-IRM/0	The potential for solid waste to migrate is very small.
Low-Priority Facilities				
116-DR-10 (Fuel Storage Basin Cleanout Percolation)	Site is inactive; it received processed shielding water from the 105-DR Fuel Storage Basin.	No intrusive activities are planned.	Defer	Potential for hazardous or radioactive contamination is very small.
118-DR-2 (105-DR Reactor Building)	Site was active from 10/3/50 through 12/30/64; contains an estimated 13,500 Ci of radionuclides, 85 metric tons of lead, 3 cubic meters of asbestos and 500 pounds of cadmium.	N/A	Defer	The potential for solid waste to migrate is very small.

Table ES-1 100-DR-2 Investigation (Page 6 of 6)

Site (Alias)	Comments	Investigation Approach	Pathway/Boreholes (Test Pit)	Rationale
Low-Priority Facilities (cont)				
122-DR-1 (105-DR Sodium Fire Facility)	Site was active from 1972-1986; site wastes consist of sodium, lithium, and sodium potassium alloy. Approximately 20,000 Kg are managed at this facility each year. The facility also stores up to 20,000 L of dangerous wastes.	RCRA TSD facility; coordinate with closure Part A Permit, Part B Permit; interim closure plan has been submitted for this site.	Defer	
132-DR-2 (116-DR Reactor Exhaust Stack)	The site was active from 1950-1986; waste is solid low-level waste. The unit is a monolithic, reinforced concrete structure with a maximum wall thickness of .46 m at the base.	N/A	Defer	The potential for solid waste to migrate is very small.
1607-D-1 (Septic Tank and Associated Drain Field)	Site is inactive; it received sanitary waste from the 1701-D and 1709-D facilities.	No intrusive activities are planned; action is deferred pending resolution of common septic system approach.	Defer	Potential for hazardous or radioactive contamination is very small.
1607-D-3 (Septic Tank and Associated Drain Field)	Site was started in 1944 and is currently active; receives sanitary waste from the 151-D Electrical Distribution Substation. The flow rate of this unit is estimated at a maximum of 3,975 L/day.	No intrusive activities are planned, action is deferred pending resolution of common septic system approach.	Defer	Potential for hazardous or radioactive contamination is very small.

HRS = hazard ranking system
IRM = interim remedial measure
LFI = limited field investigation
defer = these sites will be addressed with the final remediation of the site.

ACRONYMS

ARCL	Allowable Residual Contaminant Levels
ARAR	applicable or relevant and appropriate requirement
ASTM	American Society for Testing and Materials
CAR	corrective action requirement
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CFR	Code of Federal Regulations
CLP	contract laboratory program
CMS	corrective measures study
CRDL	contract required detection limit
CRQL	contract required quantitation limit
CRP	Community Relations Plan
CWA	Clean Water Act
DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy - Richland Operations Office
DOW	description of work
DQO	data quality objective
Ecology	Washington State Department of Ecology
EII	environmental investigations instructions
EPA	U.S. Environmental Protection Agency
ERA	expedited response action
FS	feasibility study
GC	gas chromatography
GPR	ground penetrating radar
HASM	Hanford Analytical Services Management
HEHF	Hanford Environmental Health Foundation
HEIS	Hanford Environmental Information System
HRS	hazard ranking system
HSBRAM	Hanford Site Baseline Risk Assessment Methodology
HSP	Health and Safety Plan
HSWA	Hazardous and Solid Waste Amendments (of 1984)
HWOP	hazardous waste operations permit
IMO	Information Management Overview
IRM	interim remedial measure
IU	isolated unit
JSA	job safety analysis
LFI	limited field investigation
LLW	low level waste
LSR	large-scale remediation
MDL	method detection limit
MTCACR	Model Toxics Control Act Cleanup Regulations
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NPL	National Priorities List

ACRONYMS (cont)

NRDA	natural resource damage assessment
OSHA	Occupational Safety and Health Administration
PARCC	precision, accuracy, representativeness, completeness, and comparability
PCB	polychlorinated biphenyl
PNL	Pacific Northwest Laboratory
PQL	practical quantitation limits
QA	quality assurance
QAPI	QA program index
QAPjP	Quality Assurance Project Plan
QC	quality control
QI	Quality Instruction
QR	Quality Requirement
QRA	qualitative risk assessment
RCRA	Resource Conservation and Recovery Act (of 1976)
RFI	RCRA facility investigation
RI	remedial investigation
ROD	record of decision
RPD	relative percent difference
RWP	radiation work permits
TAL	target analyte list
TCL	target compound list
Tri-Party Agreement	Hanford Federal Facility Agreement and Consent Order
TRU	transuranic waste
TSD	treatment, storage, and disposal
UTL	upper threshold limit
VOA	volatile organics analysis
WAC	Washington Administrative Code
WHC	Westinghouse Hanford Company
WIDS	Waste Information Data System
WISHA	Washington Industrial Safety and Health Act
XRF	X-ray fluorescence

CONTENTS

CONTENTS (cont)

CONTENTS (cont)

FIGURES (cont):

TABLES:

THIS PAGE INTENTIONALLY LEFT BLANK

1.0 INTRODUCTION

Four areas of the Hanford Site (the 100, 200, 300, and 1100 Areas) have been included on the U.S. Environmental Protection Agency's (EPA) National Priorities List (NPL) under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA). Figure 1-1 shows the location of these areas. Under the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1990a), signed by the Washington State Department of Ecology (Ecology), EPA, and the U.S. Department of Energy (DOE), more than 1,000 inactive waste disposal and unplanned release sites on the Hanford Site have been grouped into a number of source and groundwater operable units. These operable units may contain contamination in the form of radioactive waste (low level waste [LLW] and transuranic waste [TRU]), hazardous waste, radioactive/hazardous mixed waste, and other CERCLA hazardous substances. Also included in the Tri-Party Agreement are 55 Resource Conservation and Recovery Act (RCRA) treatment, storage, and/or disposal (TSD) facilities that will be closed or permitted to operate in accordance with RCRA regulations, under the authority of Chapter 173-303 Washington Administrative Code (WAC). Some of the TSD facilities are included in the operable units.

The Tri-Party Agreement requires that the cleanup programs at the Hanford Site integrate the requirements of CERCLA, RCRA and Washington State's dangerous waste (the State's RCRA-equivalent) program. The EPA maintains authority for CERCLA, and Ecology implements RCRA under the authority of the State's dangerous waste program. The State has also received authorization to implement the EPA's radioactive mixed waste program. The state does not yet have authority to implement the most recent amendments to RCRA, the Hazardous and Solid Waste Amendments (HSWA); this authority remains under EPA. A comparison of CERCLA and RCRA terminology used in this work plan is provided in Table 1-1. Pursuant to the Tri-Party Agreement, the 100-DR-2 Operable Unit is subject to RCRA corrective action authority.

1.1 IMPLEMENTATION OF RCRA FACILITY INVESTIGATION/CORRECTIVE MEASURE STUDY

This work plan and the referenced supporting project plans establish the operable unit setting and the objectives, procedures, tasks, and schedule for conducting the RCRA facility investigation/corrective measures study (RFI/CMS) for the 100-DR-2 Source Operable Unit. Source operable units include facilities and unplanned release sites that are potential sources of contamination. The 100-DR-2 Operable Unit consists predominantly of liquid waste disposal facilities and solid waste burial grounds, and it also contains septic tanks, a reactor building, a TSD facility, and a landfill that is no longer active. It is located near the Columbia River in the northwest portion of the Hanford Site designated as the 100 D/DR Area. The associated groundwater operable unit for this area is the 100-HR-3 Operable Unit. It underlies the 100 D/DR and H Areas, the 600 Area between them, and the ~~six~~five source operable units these areas contain (Figure 1-2). The 100-HR-3 Operable Unit includes all contamination found in the aquifer soils and water within its boundary. Separate work plans have been completed for the 100-HR-3 Groundwater Operable Unit, the 100-DR-1 and the 100-HR-1 Source Operable Units.

All work conducted under this plan will conform to the conditions set forth in the Tri-Party Agreement and its amendments. In accordance with the Tri-Party Agreement, relevant EPA guidance documents were consulted in the preparation of the work plan, including the following:

- *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA; Interim Final* (EPA 1988a)

- *Data Quality Objectives for Remedial Response Activities: Volume 1, Development Process* (CDM Federal Programs Corporation 1987)

- *Superfund Exposure Assessment Manual* (EPA 1988b)

- *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual; Interim Final* (EPA 1989a)

- *Risk Assessment Guidance for Superfund, Volume II, Environmental Evaluation Manual; Interim Final* (EPA 1989b).

This chapter is designed to set forth the general purpose, scope and goals of the project without repeating material from preceding documents, and to focus more on site specific aspects of the 100-DR-2 Operable Unit. Additional data regarding processes, strategies and background information can be found in the *RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-HR-3 Operable Unit, Hanford Site, Richland, Washington* (DOE-RL 1992a) and the *RCRA Facility Investigation/Corrective Measure Study Work Plan for the 100-DR-1 Operable Unit, Hanford Site, Richland, Washington* (DOE-RL 1992b).

1.2 PROJECT GOALS

The approach described in this work plan is based on the *Hanford Site Past-Practice Strategy* (DOE-RL 1991a). This strategy streamlines the past-practice remedial action process with a bias for action through optimizing the use of interim actions. The goal of the 100-DR-2 Operable Unit RFI/CMS is to provide sufficient information to optimize the use of IRM to expedite cleanup, while still maintaining a technically sound and cost-effective program of investigations that culminates with a decision of final remedial actions on both an operable unit and 100 Area aggregate scale. The strategy focuses on reaching early decisions (IRM pathway) to initiate and complete cleanup projects, maximizing the use of existing data (historical and analogous facilities), coupled with focused short time-frame LFI where necessary.

Source operable units are units which contain facilities and unplanned release sites that are potential sources of hazardous substance contamination. The 100-DR-2 Operable

Unit is one of the ~~three~~two source operable units in the 100 DR Area. The 100-DR-1 and 100-DR-2 Source Operable Units are concerned with reactor liquid effluent sites and ~~the 100-DR-3 Source Operable Unit is concerned with~~ solid and buried wastes. These ~~three~~ two operable units are underlain by the 100-HR-3 Operable Unit which is the groundwater operable unit beneath the 100 H and 100 D/DR Areas.

The 100-DR-2 Operable Unit is a reactor liquid effluent site operable unit. It consists predominantly of reactor liquid effluent sites, solid waste burial grounds, and also contains a septic system and several demolished facilities. It is located near the Columbia River in the northeast portion of the Hanford Site designated as the 100 D/DR Area. The 100-HR-3 Operable Unit includes all contamination found in the aquifer soils and water within its boundary. Separate work plans have been initiated for the 100-HR-3 Groundwater Operable Unit (DOE-RL 1992a), the 100-DR-1 Source Operable Unit (DOE-RL 1992b) and *RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-HR-1 Operable Unit, Hanford Site, Richland, Washington* (DOE-RL 1992c). Limited field investigations have been conducted at these operable units. An expedited response action (ERA) has been initiated at the 100-IU-4 Isolated Unit (IU).

The work scope described in the work plan is a result of the scoping process which involved Ecology, EPA, and DOE. The pathway selected during the scoping process for the reactor liquid effluent sites and the solid waste burial grounds in the 100-DR-2 Operable Unit is the IRM pathway.

The waste sites in the 100-DR-2 Operable Unit fall into three categories: high-priority sites; solid waste burial grounds; and low-priority sites. Table ES-1, which lists all the sites, presents the following information: identifies the sites requiring an LFI, identifies the sites where there is/is not enough information, and identifies which sites will follow the regular RFI/CMS approach. ~~Six~~Twelve waste sites in the 100-DR-2 Operable Unit received scores from the *Hazard Ranking System Evaluation of CERCLA Inactive Waste Sites at Hanford* (Stenner et al. 1988). Scores in the 100-DR-2 Operable Unit ranged from 0.0 to 42.32. Sites with scores above 28.5 are to be listed on the NPL. The entire 100 Area is on the NPL, however the 28.5 is used as a screening threshold and will therefore be used in a similar fashion to indicate the need for specific waste units at the operable units (OU) to follow the LFI/IRM path. (These ~~six~~twelve sites were the only sites known at the time of the hazard ranking system [HRS] scoring). The ~~six~~ twelve sites and their respective HRS scores are: 116-DR-3 (40.09), 116-DR-4 (9.13), 116-DR-6 (42.32), 116-DR-7 (28.96), ~~and~~116-DR-8 (0.00), 118-D-1 (1.84), 118-D-2 (2.76), 118-D-3 (2.76), 118-D-4 (1.84), 118-D-5 (1.89), 118-DR-1 (1.84), and 128-D-1 (0.13).

As a result of the scoping studies and the work done in preparing the work plan, the historical information and this information from similar facilities were determined to be sufficient to formulate conceptual models and perform a qualitative risk assessment (QRA) following the IRM pathway. The emphasis in this site work plan is on describing those data that will be obtained at the high-priority sites to develop the conceptual model, conduct the QRA, evaluate the corrective action requirements (CAR), conduct a focused feasibility study (FS), and prepare the IRM determination. Work performed during the scoping phase and in developing the work plan indicates that intrusive activities are required during the conduct of the LFI for the 100-DR-2 Operable Unit. The three sites that require intrusive investigations are: 116-DR-3, 116-DR-7, and the Sodium Dichromate/Acid Pumping Station. The work on low-priority sites will be deferred until the final remedy selection process.

The LFI report for the 100-DR-2 Operable Unit will be prepared which will include the results of the historical investigations, analogous site investigations, process knowledge, field screening, and the scoping phase geophysical surveys; identification of the nature and extent of contamination at the high-priority sites; identification of contaminant- and location-specific applicable or relevant and appropriate requirements (ARAR); and a summary of the QRA performed for the high-priority sites. The report will include an assessment of whether the IRM pathway should continue to be followed for each waste site. The LFI report will provide support for the focused FS, which will address final remediation options for the waste sites.

The FS process for the 100 Area will be conducted on both an aggregate area and operable unit basis. This process includes preparation of a 100 Area FS, a focused FS, and implementation of remedial actions for individual operable units.

1.3 ORGANIZATION OF THE WORK PLAN

This work plan is organized in the same manner as the 100-DR-1 Operable Unit Work Plan (DOE-RL 1992b), but utilizes the philosophy of incorporation by reference. Information that is not specific to the 100-DR-2 Operable Unit is referenced to either the 100-HR-3 (DOE-RL 1992a) or 100-DR-1 (DOE-RL 1992b) Work Plans.

1.4 QUALITY ASSURANCE

The 100-DR-2 Operable Unit Work Plan and its supporting project plans have been developed to meet specific EPA guidelines for format and structure, within the overall quality assurance (QA) program structure mandated by DOE - Richland Operations Office (DOE-RL) for all activities at the Hanford Site. The 100-DR-2 Operable Unit Quality Assurance Project Plan (QAPjP) (Appendix A) supports the field sampling program described in Chapter 5.0. It defines the specific means that will be used to ensure that the sampling and analytical data obtained as part of the LFI and aggregate area studies will effectively support the purposes of the investigation. As required by the Westinghouse Hanford Company (WHC) QA Program for RFI/CMS activities and the *Hanford Federal Facility Agreement and Consent Order* (Ecology 1990a), the structure and content of the QAPjP are based on *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans* (Stanley and Verner 1983). Where required, the QAPjP invokes appropriate procedural controls selected from the Westinghouse Hanford Company QA Program Plan for RFI/CMS activities, or specifically developed to accommodate the unique needs of this investigation.

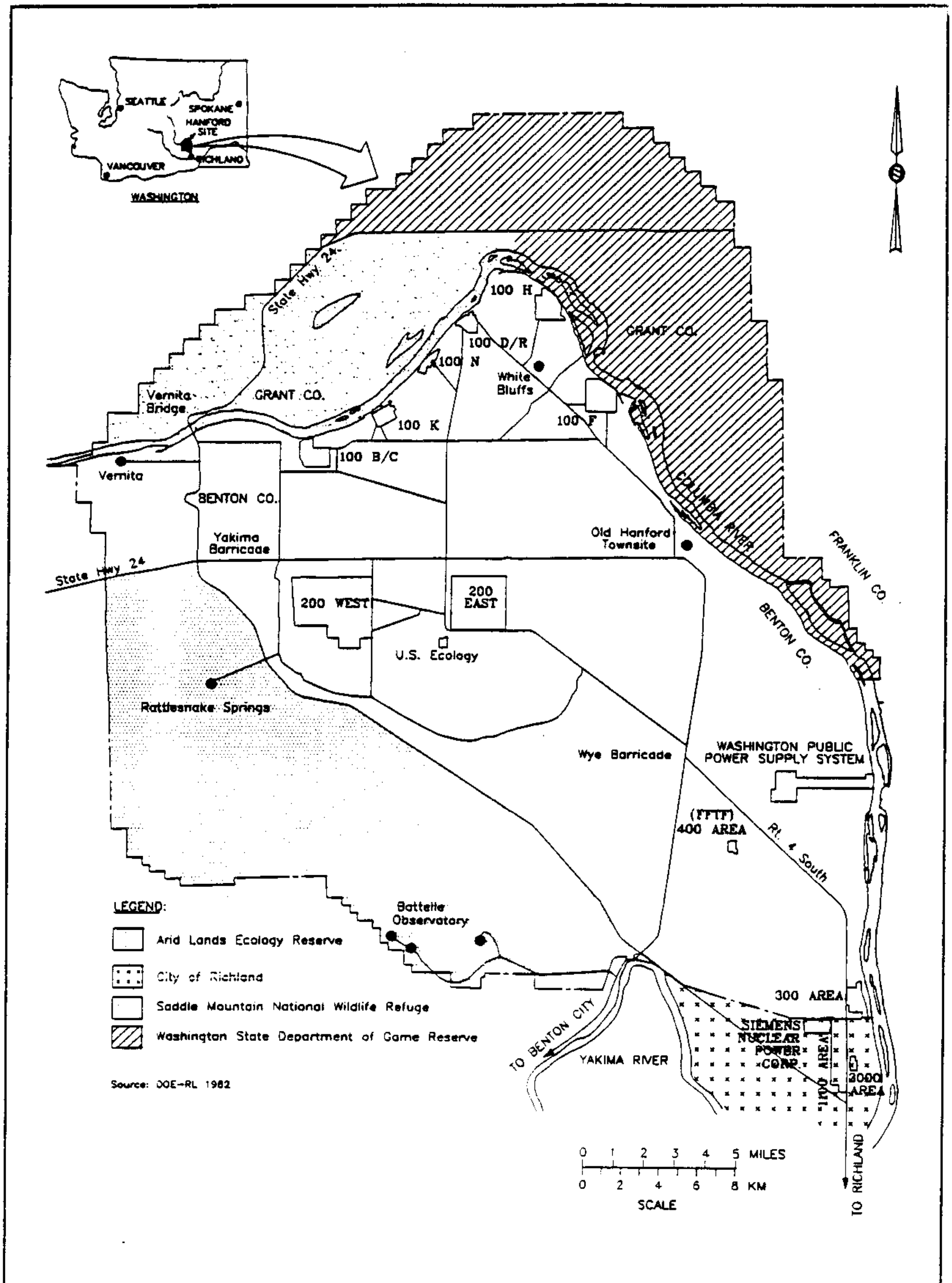
1.5 NATURAL RESOURCE DAMAGE ASSESSMENT

The Clean Water Act (CWA) and CERCLA provide that natural resource trustees may assess damages to natural resources resulting from a discharge or release of a hazardous substance and may seek to recover those damages. According to the National Contingency Plan (NCP), the lead agency shall make available, information and documentation that can assist the respective trustees in the determination of actual or potential natural resource injuries.

To that end, for RCRA corrective action units, the trigger for Natural Resource Damage Assessment (NRDA) is the discharge or release of a hazardous substance. Potential injury from past releases will need to be identified. Potential future injuries, as a result of remedial/removal actions, will need to be considered in the context of NRDA. The NRDA considerations are important prior to establishing the ecological remedial/removal action objectives.

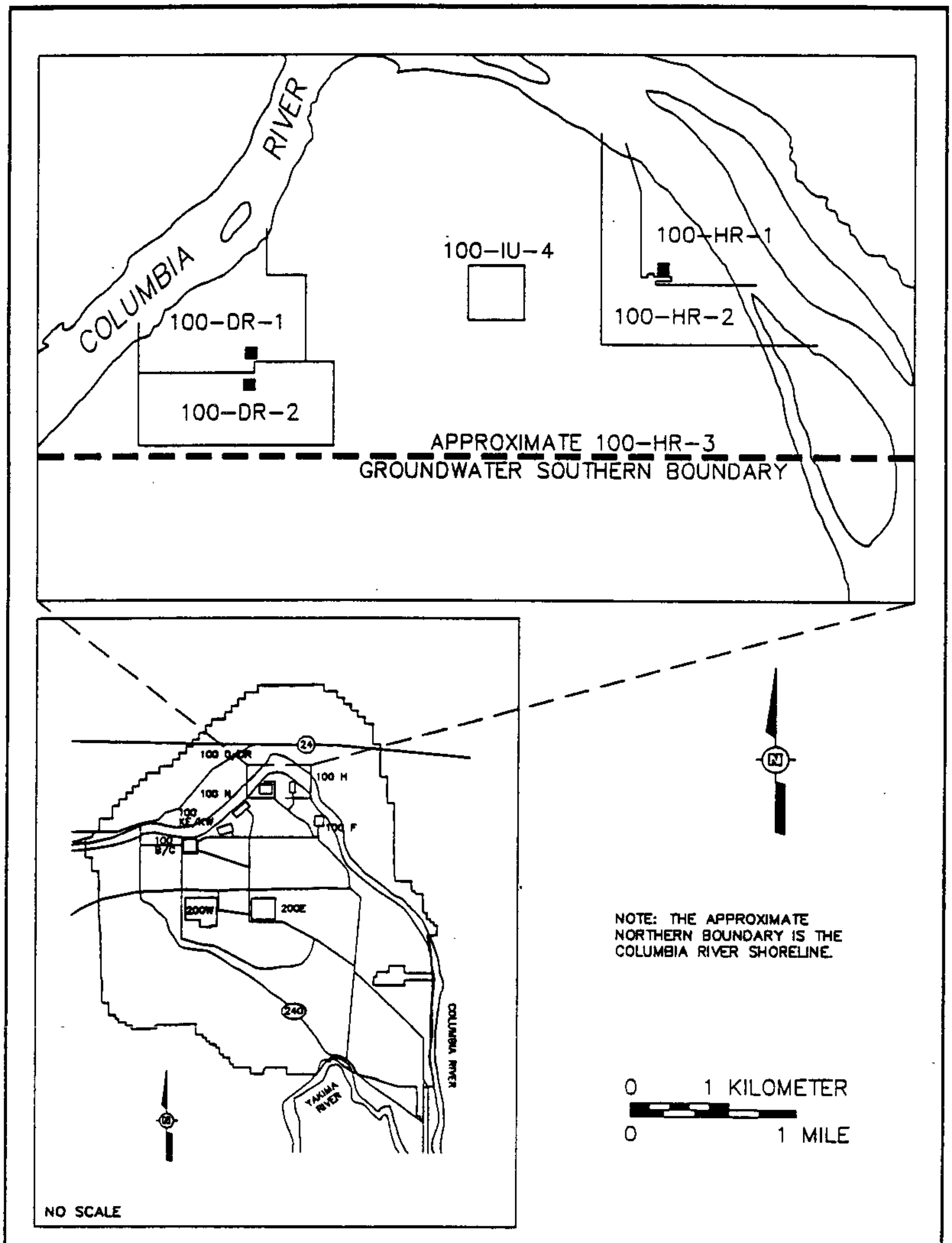
THIS PAGE INTENTIONALLY LEFT BLANK

Figure 1-1 Hanford Site



THIS PAGE INTENTIONALLY
LEFT BLANK

Figure 1-2 Map of the 100-HR-3 Groundwater Operable Unit, Showing the Associated Source Operable Units



WPIF2

THIS PAGE INTENTIONALLY
LEFT BLANK

Table 1-1 The Relationship Between RCRA and CERCLA Terminology Used in this Work Plan

RCRA Terminology	CERCLA Terminology
Resource Conservation and Recovery Act Facility Investigation (RFI)	Remedial Investigation (RI)
Corrective Measures Study (CMS)	Feasibility Study (FS)
Limited Field Investigation (LFI)	Limited Field Investigation (LFI)
Focused Feasibility Study (Focused FS)	Focused Feasibility Study (Focused FS)
Expedited Response Action (ERA)	Expedited Response Action (ERA)
Interim Response Measure (IRM)	Interim Response Measure (IRM)
Proposed IRM Plan	Proposed IRM Plan
IRM Record of Decision (ROD)	IRM Record of Decision (ROD)
IRM Design Report	IRM Design Report
IRM Implementation	IRM Implementation
Proposed Corrective Action Plan	Proposed Remedial Action Plan
Corrective Action ROD	Remedial Action ROD
Corrective Action Design Report	Remedial Action Design Report
Corrective Action Implementation	Remedial Action Implementation
Corrective Action Requirement (CAR)	Applicable or Relevant and Appropriate Requirement (ARAR)

THIS PAGE INTENTIONALLY
LEFT BLANK

2.0 OPERABLE UNIT BACKGROUND AND SETTING

This chapter presents a summary, based on available data, of the pertinent physical, historical, biological, and sociological settings for the 100-DR-2 Operable Unit. Chemical and radiological data representing the known and suspected nature and extent of contamination, as well as the background conditions of the local environmental media, are presented.

2.1 OPERABLE UNIT DESCRIPTION

The 100 D/DR Area at the Hanford Site was used by the U.S. Government from 1944 to 1967 for plutonium production reactors and related operational support facilities. These operations resulted in the release of chemical and radioactive wastes into the soil, air, and water. For cleanup purposes, the 100 D/DR Area has been divided into ~~four~~three operable units, ~~three~~ two of which are concerned with sources and solid waste burial grounds (100-DR-1 and 100-DR-2~~and 100-DR-3~~) while the ~~fourth~~third (100-HR-3) is concerned with groundwater beneath and between the 100 H and 100 D/DR Areas, including all saturated soils, groundwater, surface water and aquatic biota. The 100-DR-1 and 100-DR-2 Operable Units, designated as reactor effluent waste sources, each contain a reactor building and associated support facilities within the operable unit boundaries, and ~~The 100-DR-3 Operable Unit contains~~ solid waste disposal units associated with operations at the 118-D-6 (105-D) and 118-DR-2 (105-DR) Reactors. Figure 2-1 shows in detail the boundaries of the source operable units.

The purpose of this section is to describe the location of the 100 D/DR Area, the history of operations in the area, the facilities and structures located in the 100-DR-2 Operable Unit, and the contamination associated with each facility, structure or waste unit.

2.1.1 Location

The 100-DR-2 Operable Unit is situated within the 100 D/DR Area of the DOE Hanford Site located in the south-central portion of the state of Washington. The 100 D/DR Area is located in Benton County along the south bank of the Columbia River in the north-central part of the Hanford Site, approximately 50 km (31 mi) north-northwest of the city of Richland, Washington, as shown in Figure 1-1.

~~The 100-DR-2 Operable Unit encompasses an area south of the 100-DR-1 Operable Unit which is bounded on the south and east by the 100-DR-3 Operable Unit. The 100-DR-2 Operable Unit extends eastward from a boundary common to all three operable units to a point just east of the 118-DR-2 (105-DR) Reactor Building. It lies predominantly within the northeast quadrant of Section 22 and the northwest quadrant of Section 23 of T.14 N., R.26 E., and is located within latitude 46°41' and 46°41'10" north and longitude 119°33' and 119°32' west.~~

The 100-DR-2 Operable Unit encompasses an area south of the 100-DR-1 Operable Unit and is bounded on the south and east by the 100 D Area perimeter road. It lies predominantly within the northeast/southeast quadrants of Section 22 and the northwest/southwest quadrants of Section 23 of Township 14N., Region 26E., and is located within latitude 46°41' and 46°41'10" north and longitude 119°33' and 119°32' west.

2.1.2 History of Operations

2.1.2.1 Reactor Operations. Between 1943 and 1963, nine water-cooled graphite moderated plutonium production reactors were built along the Columbia River upstream from the now-abandoned town of Hanford. These nine reactors (B, C, D, DR, F, H, KE, KW, and N) have been retired from service and are under evaluation for decommissioning.

The 100 D/DR Area contains the D and DR Reactors and their operational support facilities. The D Reactor is located in the 100-DR-1 Operable Unit, and the DR Reactor is located in the 100-DR-2 Operable Unit, and support facilities are distributed throughout both units. Fuel elements for the reactors were manufactured in the 300 Area, and the plutonium-enriched fuel produced by the reactors was processed in the 200 Areas. The D Reactor operated from 1944 to 1967, when it was retired. The DR Reactor operated from 1950 to 1964, when it was also retired. Currently, sanitary and fire-protection water is provided to the 100 H and 100 F Areas from the 100 D/DR Area. The water system is also a backup for systems in the 100 B Area that supply the 200 Areas.

The 100 D/DR Area support facilities for the DR Reactor included an access road, rail spur, warehouse, major electrical substation, and several intermediate smaller substations (located throughout both the 100-DR-1 and 100-DR-2 Operable Units), and maintenance shops. Additional facilities include a water reservoir, filter plant, a sanitary water supply system, a process effluent system, a subsurface sanitary sewage disposal system, and a solid waste landfill. Many of the above-ground facilities have undergone some degree of decommissioning, and in many instances facilities no longer exist.

2.1.2.2 Post-Reactor Operation Activities. Currently the active facilities existing within the boundaries of the 100-DR-2 Operable Unit are the septic tank and electrical substation. To minimize the potential spread of radioactive isotopes from the reactors and associated facilities, DOE instituted a program of decontamination and decommissioning of buildings and facilities after the reactors were retired. The process is ongoing, and in the 100 D/DR Area many of the above ground facilities have undergone decommissioning and no longer exist. The layout of the 100-DR-2 Operable Unit, illustrating both present and past facilities, is shown in Figure 2-2. Shading is used to indicate structures that have been demolished since reactor deactivation.

2.1.3 Facility Characteristics and Identification

The following sections describe the facilities and structures originally located in the 100-DR-2 Operable Unit. All 100-DR-2 Operable Unit waste facilities can be grouped into the following general categories:

- reactor building and associated disposal facilities
- contaminated reactor ancillary facilities
- sanitary sewage, transfer, treatment, and disposal facilities
- RCRA-permitted facilities
- support facilities
- solid waste landfill, burial grounds
- electrical facilities.

Table 2-1 lists each of the 100-DR-2 facilities identified during the background research phase of this project. Photographs, drawings, reports, and field visits were used as much as possible to locate all of the facilities. Each facility is listed, followed by the appropriate *Hanford Site Waste Information Data System* (DOE-RL 1991b) site number with any alias names shown in parenthesis, facility name, years in service and present status, and types of wastes received or produced. These facilities are shown on Figure 2-2.

2.1.3.1 Reactor Building and Associated Disposal Facilities. This category includes all facilities involved with the 118-DR-2 Reactor and the effluent generated by reactor operations, decontamination activities, and fuel storage that were not discharged immediately into the process effluent pipelines.

2.1.3.1.1 118-DR-2 (105-DR) Reactor Building. This building houses the plutonium production reactor, which is no longer operational. The 118-DR-2 Building is located in the northeast corner of the operable unit. It is surrounded by a placarded chain-link security fence.

The 118-DR-2 Building operated from 1950 to 1964. The building consists of the following:

- the reactor moderator stack, an assembly of graphite blocks with channels from the process tubes, control rods, and other equipment

- the process tubes that held the uranium metal fuel elements and provided channels for cooling water

- control rods, fuel handling equipment, monitoring equipment, and experimental test holes

- the thermal and biological shields

- a welded steel-plate box that encloses the biological shield and served to confine the gas atmosphere within the reactor

- reactor work areas, instrument room, decontamination station
- Sodium Fire Facility (now a RCRA TSD), located in the supply and exhaust fan wing
- an irradiated-fuel storage basin, as reported in the *Radiological Characterization of the Retired 100 Areas* (Dorian and Richards 1978).

The reactor building was the source of much of the contamination in the 100-DR-2 Area, although it is not designated as a component of the 100-DR-2 Operable Unit area. The decommissioning of the 105-DR Reactor, along with the other 100 Area retired reactors, is the subject of a draft environmental impact statement, as reported in the *Environmental Restoration Field Office Management Plan* (DOE-RL 1989), and is not within the scope of this work plan.

2.1.3.1.2 116-DR-4 (105-DR) Pluto Crib. The 116-DR-4 site received 4,000 liters (1,000 gal) of liquid wastes isolated from tubes containing ruptured fuel elements in the 105-DR Reactor. Based upon the estimated volume of liquid discharged to the Pluto Crib, an estimated total of 0.004 kg of sodium dichromate was disposed to this crib (Stenner et al. 1988). This site is analogous to 116-D-2A (the rational for analogous sites is that the sites had the same process options, similar geology and like soil conditions).

The Pluto Crib radionuclide inventory in curies decayed through April 1, 1986, includes the following (Stenner et al. 1988):

Cobalt-60	1.180E-03	Europium-155	1.800E-04
Strontium-90	4.34E-03	Plutonium-239	9.000E-05
Cesium-137	3.810E-02	Plutonium-240	1.000E-05
Europium-152	3.150E-03		

Additionally, Dorian and Richards (1978) reports the results of soil samples taken from three locations.

RADIONUCLIDE	AVE. pCi/g	CURIES
Tritium		0.00
Cobalt-60	2.20E+00	3.50E-03
Strontium-90	3.30E+00	5.30E-03
Cesium-134	1.60E-02	2.60E-05
Cesium-137	2.90E+01	4.60E-02
Europium-152	3.00E+00	4.80E-03
Europium-154	3.60E-01	0.00
Europium-155	6.30E-02	5.80E-04
Plutonium-238		0.00
Plutonium-239/240		1.00E-04
TOTAL CURIES		6.00E-02

The crib was small, 3 m (10 ft) x 3 m (10 ft) x 3 m (10 ft) deep, constructed of railroad ties and gravel-filled as reported in Waste Information Data System (WIDS) (DOE-RL 1991b).

2.1.3.1.3 116-DR-3 (105-DR) Storage Basin Trench. The 116-DR-3 (105-DR) Storage Basin Trench is an inactive liquid waste site that operated during 1955. This is an 18 m (60 ft) x 12 m (40 ft) x 3 m (10 ft) deep trench. This site received 4,000,000 liters (1,000,000 gal) of contaminated sludge and water from the 105-DR Fuel Storage Basin.

The Storage Basin Trench radionuclide inventory in curies decayed through April 1, 1986, includes the following (Stenner et al. 1988):

Tritium	2.080E-01	Europium-152	1.970E-02
Cobalt-60	1.010E-02	Europium-154	3.090E-03
Strontium-90	5.150E-02	Plutonium-239	2.970E-03
Cesium-134	1.000E-05	Plutonium-240	3.300E-04
Cesium-137	3.560E-02		

Additionally, Dorian and Richards (1978) reports the results of soil samples taken from four locations in the trench.

RADIONUCLIDE	AVE. pCi/g	CURIES
Tritium	1.30E+02	3.30E-01
Cobalt-60	1.20E+01	3.00E-02
Strontium-90	2.50E+01	6.30E-02
Cesium-134	7.00E-02	1.80E-04
Cesium-137	1.70E+01	4.30E-02
Europium-152	1.20E+01	3.00E-02
Europium-154	2.40E+00	6.00E-03
Europium-155	3.20E-01	8.00E-04
Plutonium-238	1.30E+00	0.00
Plutonium-239/240		3.30E-03
TOTAL CURIES		5.10E-01

2.1.3.1.4 116-DR-6 (1608-DR) Liquid Disposal Trench. The 116-DR-6 Liquid Disposal Trench is an inactive liquid waste site that operated from 1953 to 1965. This trench received coolant that was diverted to the trench during the Ball 3X upgrade. It also received diverted water when maintenance on the effluent system was necessary.

The 15 m (50 ft) x 3 m (10 ft) x 3 m (10 ft) deep trench received an estimated 7,000,000 liters (1,849,204 gal) of waste effluent. Based upon the estimated volume of liquid discharged to the trench, an estimated total of 2.0 kg (4.4 lb) of sodium dichromate was disposed to this trench (Stenner et al. 1988). No radionuclide inventory is available for this facility. This site is analogous to 116-DR-1 and 116-DR-2 (the rationale for analogous sites is that the sites had the same process options, similar geology and like soil conditions). Upon closure it was covered with about 2 m (6 ft) of clean soil (WIDS) (DOE-RL 1991b).

2.1.3.1.5 116-DR-7 (105-DR) Inkwell Crib. The 116-DR-7 (105-DR) Inkwell Crib is an inactive liquid waste site that operated during 1953. The 116-DR-7 Inkwell Crib was used to receive the liquid potassium borate solution that was drained from the 3X system prior to the Ball 3X system upgrade. This site received 4,000 liters (1000 gal) of liquid potassium borate. There is reason to believe the site may be a storage tank rather than a crib. About 3,000 kg (6,600 lb) of potassium borate was disposed in this site (Stenner et al. 1988). The radionuclide inventory for the 116-DR-7 Crib, decayed through April 1, 1986, was reported by Stenner et al. (1988) as 0.101 Ci.

The 1.5 m (5 ft) x 1.5 m (5 ft) x 3 m (10 ft) deep crib is a registered underground injection well.

2.1.3.1.6 116-DR-8 (117-DR) Seal Pit Crib. The 116-DR-8 (117-DR) Crib is an inactive liquid waste site that operated from 1960 to 1964 for reactor operations and until 1986 in support of the 105-DR Sodium Fire Facility.

The 3 m (10 ft) x 3 m (10 ft) x 3 m (10 ft) deep 116-DR-8 Crib received an estimated 240,000 liters (63,401 gal) of liquid wastes from the containment system 117-DR Building Seal Pit. No radionuclide inventory is available for this facility.

2.1.3.2 Contaminated Reactor Ancillary Facilities. This includes all facilities involved with the secondary wastes from the 118-DR-2 Reactor Building maintenance activities that may involve irradiated products.

2.1.3.2.1 116-D-8 (100-D) Cask Storage Pad. The 116-D-8 (100-D) Cask Storage Pad is an inactive solid waste site that operated from 1946 to 1975. The cask pad was used to store shipping and handling casks when they were not in use. The cask pad is a concrete pad with two drains. One of the drains facilitated rain runoff and the disposal of minor decontamination solutions. This drain discharged into the 105-DR Process Sewer. The second drain was for decontamination use and emptied into a french drain. The location of the french drain is currently unknown. No radionuclide inventory is available for this facility.

There are two devices standing to the south of the cask pad: a tank, about 12 ft tall by 10 ft in diameter, labeled Alum Storage; and a structure about 8 ft tall by 10 ft in diameter, that appears to be a furnace. The exterior of the Alum Storage tank is marked with Internal Radioactive Material warning stickers. No radionuclide inventory is available for these devices.

2.1.3.2.2 132-DR-1 (1608-DR) Waste Water Pumping Station. The 132-DR-1 (1608-DR) Waste Water Pumping Station is an inactive liquid waste site that operated from 1950 to 1964. The pump station has been decommissioned. The unit was adjacent to the northeast corner of the 118-DR-2 (105-DR) Reactor Building within the 105-D/DR exclusion area fence. The 1608-DR facility received water from reactor building drains containing trace amounts of low-level radionuclides and decontamination chemicals. Radionuclides were primarily miscellaneous fission and activation products. The decontamination chemicals consisted of sodium fluoride, oxalic acid, and citric acid. No radionuclide inventory is available for this site.

2.1.3.2.3 132-DR-2 (116-DR) Reactor Exhaust Stack. The 132-DR-2 (116-DR) Reactor Exhaust Stack is an inactive solid waste site that operated from 1950 to 1986. The stack is located on the south side of 118-DR-2 (105-DR). The stack was used to exhaust air from the 105-DR Reactor work areas and later from the 122-DR-1 (105-DR) Sodium Fire Facility. The stack is a monolithic, reinforced concrete structure with a maximum wall thickness of 1.5 ft at the base. It rests on a double octagon-shaped base that extends 17.5 ft below grade.

2.1.3.2.4 Sodium Dichromate/Acid Pumping Station. The sodium dichromate/acid pumping station is located just south of the 184-D Building next to the railroad tracks. A 3-inch diameter buried pipeline transported solutions from the pump station to storage tanks located at 185-D and outside 190-DR. There is a 1 m diameter french drain located at the site. The french drain received liquids from the flushing and draining of the hoses and lines used to off-load the railcars and tank cars. No radionuclide or chemical contaminant inventories are available for this facility. However, chromium is a potential contaminant at this site.

2.1.3.2.5 116-DR-10 (105-DR) Fuel Storage Basin Cleanout Percolation (Fuel Storage Discharge Pond; 105-DR Pond). The 116-DR-10 (105-DR) Fuel Storage Basin Cleanout Percolation is an inactive liquid waste site that operated from October 1984 to November 1984. The site was located 150 m east and slightly south of the 105-DR Reactor Building.

The 116-DR-10 facility received processed water from the 105-DR Fuel Storage Basin. During the cleanout of the 105-DR Fuel Storage Basin, the radioactively contaminated shielding water was processed through an ion exchange system (Miller and Steffer 1986). Prior to discharging this water to the 116-DR-10 site, composite samples were taken to ensure that radionuclide concentrations were below the release criteria stated in Table II of DOE Order 5480.1. Although the water was cleaned to applicable release limits, minute quantities (below release limits) of radionuclides remaining in the water accumulated in the soil at some low points of the floor. No known hazardous substances were present in the water; however, chemical analysis was not a standard practice during that period. The contaminated soil was removed and the site was released using Allowable Residual Contaminant Levels (ARCL) methodology.

2.1.3.3 Sanitary Sewage, Transfer, Treatment, and Disposal Facilities. Sanitary sewage generated at the 100 D/DR Area was treated in underground septic tanks and then discharged to tile fields. There is no documentation of hazardous wastes being disposed of in any of these facilities.

2.1.3.3.1 1607-D Septic Tanks and Associated Drain Fields. ~~One septic tank system is located in the 100-DR-2 Operable Unit. It is active and supports the 151-D Electrical Substation. This facility is not known to have received hazardous or radioactive wastes, although it supports a facility where hazardous and/or radioactive materials may have been routinely handled and used. Of these, solvents and polychlorinated biphenyl (PCB) contaminated oils are most likely to have been used, although only in very small concentrations. They would have been generated by hand washing and small parts cleaning.~~ Two septic tank systems are located in the 100-DR-2 Operable Unit. The first, 1607-D-3 is an active system and supports the 151-D Electrical Substation. This facility is not known to have received hazardous or radioactive wastes, although it supports a facility where hazardous and/or radioactive materials may have been routinely handled and used. Of these, solvents and polychlorinated biphenyl (PCB) contaminated oils are most likely to have been used, although only in very small concentrations. They would have been generated by hand washing and small parts cleaning.

The second septic tank system, 1607-D-1, is inactive. In the past, it supported the 1701-D and 1709-D facilities. This system was not known to have received hazardous or radioactive wastes, although it may have received materials associated with cleaning solvents and materials that were likely used in the facilities it supported.

2.1.3.4 122-DR-1 (105-DR) Sodium Fire Facility - Resource Conservation and Recovery Act of 1976 Facilities. The 100-DR-2 Operable Unit currently contains one waste storage and treatment facility subject to permitting and/or closure as a TSD facility under RCRA; the 122-DR-1 Sodium Fire Facility. The 122-DR-1 (105-DR) Sodium Fire Facility is an inactive liquid waste site that operated from 1972 to 1986. The facility is located in the supply and exhaust fan wing of the 105-DR Reactor Building (WIDS) (DOE-RL 1991b) and includes portions of the 116-DR Reactor Exhaust Stack, the 117-DR Filter Building and associated crib (116-DR-8) and the 119-DR Reactor Exhaust Stack Sampling Building. This facility was used for the thermal testing and treatment of sodium and other alkali metals. Wastes consisted of sodium, lithium, and sodium-potassium alloy. Approximately 20,000 kg were managed at this facility each year. The facility is also used to store up to 20,000 liters of dangerous wastes. The facility was also known as the 105-DR Large Sodium Fire Facility.

2.1.3.5 Support Facilities. Located throughout the 100-DR-2 Operable Unit are facilities that provide support services so that the primary function of the reactor building, generation of plutonium, could be accomplished. Limited information was found in the background search on a majority of the buildings. It is important that all decommissioned buildings be identified so that a thorough analysis regarding waste generation and contaminant potential can be made.

The buildings that have been identified are listed in Table 2-1. These buildings/structures, (if locations are known) whether existing or demolished, are shown in Figure 2-2. The facilities that are of primary concern include the following:

- 1702-DR Exclusion Area Badge House
- Temporary Garage and Gasoline Dispensing Station
- 117-DR Filter Building
- 183-DR Filter Plant, Head House, Sedimentation and Coagulation Basins
- 190-DR Main Pump House.

2.1.3.5.1 1702-DR (105) Area Exclusion Area Badge House. The 1702-DR (105) Area Exclusion Area Badge House is located northwest of the 105-DR Reactor. This facility provided entry into the exclusion zone.

2.1.3.5.2 Temporary Garage and Gasoline Dispensing Station. During construction of the water treatment facilities for the 118-DR-2 Reactor, a temporary garage facility was built. On May 2, 1950 the garage facility was destroyed by a fire. The location of this facility is unknown. It is not known if there was an underground tank associated with this facility (generally temporary garages housed above ground storage tanks) as reported in the *100-D Area Technical Baseline Report* (WHC 1993).

2.1.3.5.3 117-DR Filter Building. Originally 105-DR exhaust air flowed directly from the 118-DR-2 Reactor Building to the exhaust stack. Following completion of the confinement project in 1960, the exhaust air was diverted to the 117-DR Filter Building, via underground ducts, prior to release through the stack.

2.1.3.5.4 183-DR Filter Plant, Head House, Sedimentation and Coagulation Basins. This facility was constructed in 1950 to supply treated cooling water to the 105-DR Reactor. As part of the deactivation of 118-DR-2, the flocculating basins were cleaned and the silt flushed from the basins. Radiation surveys of the basins after cleaning revealed beta-gamma contamination levels of < 500 counts per minute (cpm) as reported in the *DR-Plant Radiation Zones Final Status Report* (Winship 1965).

2.1.3.5.5 190-DR Main Pump House. The 190-DR Main Pump House treated water from the 183-DR Facility with sodium dichromate prior to releasing it to the 118-DR-2 Reactor.

2.1.3.6 Solid Waste Landfill and Burial Grounds.

2.1.3.6.1 126-DR-1 (190-DR) Clearwell Tank Pit. The 126-DR-1 (190-DR) Clearwell Tank Pit is an active solid waste site that began operations in the 1970's. The site is located directly east of the 183-DR Waste Treatment Facility site (demolished) and about 1,200 ft southwest of the 118-DR-2 Reactor Building.

The site is an excavated area between the 183-DR and 190-DR that contained four (14,195,294 liters [3,750,000 gal]) steel water storage tanks that were removed by a salvage contractor. Approximately 25% of the bottom surface area contains a layer of waste about 1.5 - 3 m (5 - 10 ft) deep that is covered with pit run backfill and is located in the northeast sector of the pit. The wastes placed in this area were demolition and inert waste from the decommissioned facilities, including rubble from released portions of the 115-D/DR, and some rubble from 183-DR. The southern sector is posted as an asbestos area. In 1989, small amounts of friable asbestos were found scattered throughout the southern sector. The asbestos is believed to be the result of salvage operations during the 1970's.

2.1.3.6.2 118-D-5 (Ball 3X) Burial Ground. The 118-D-5, Ball 3X Burial Ground is an inactive solid waste site that operated during 1954. This burial ground is located about 100 ft south of the 118-DR-2 (105-DR) Building, outside the exclusion area fence (WIDS) (DOE-RL 1991b). It received thimbles removed from the 105-DR Reactor during the Ball 3X upgrade project in 1954 (Stenner et al. 1988). (Thimbles were sealed aluminum tubes that ran through the graphite to maintain the gas seal in the vertical safety rod and horizontal control rod channels.) This site is also known as Minor Construction Burial Ground Number 3, as reported in *Unconfined Underground Radioactive Waste and Contamination--100 Areas* (Heid 1956).

The 118-D-5 site consists of two parallel burial trenches with one trench on each side of the existing aboveground experimental level-one discharge pipe. Each trench is 12 m (40 ft) x 6 m (20 ft) x 3 m (10 ft) deep (WIDS) (DOE-RL 1991b). It is possible that the west trench was relocated in 1960 during the construction of the 117-DR Building, so the exact location is uncertain and total volume disposed at this location is unknown. For example, the 118-DR-5 is also described as a 6 m (20 ft) x 6 m (20 ft) x 3 m (10 ft) deep single trench (Stenner et al. 1988), and as being two trenches, both located east of the experimental level discharge pipe (Hanford Drawing H-1-4046, sites 4 and 17).

2.1.3.6.3 118-D-1 (100-D) Burial Ground No. 1. The 118-D-1 Burial Ground No. 1 is an inactive solid waste site that operated from 1944-1967. This burial ground is located about 900 ft south of the 105-DR Building. It received irradiated reactor parts, dummies, thimbles, rods, gun barrels, and other contaminated solid waste.

The 118-D-1 site (450 ft x 375 ft x 20 ft) consists of many trenches oriented in a north-south direction. Typically, the trenches were 300 ft x 20 ft x 20 ft deep with a 20 ft space separating each trench. This burial ground was divided in four sections to allow grouping of like wastes in each section (Hanford Drawing H-1-4046). This site received an estimated 10,000 m^3 of waste, of which 10 m^3 was metallic waste (Stenner et al. 1988). The radionuclide inventory for the 118-D-1 Burial Ground No. 1, decayed through April 1, 1986, was reported by Stenner et al. (1988) as 1.0 Ci of cobalt-60.

The western section of the site is elevated about two feet above the rest of the area. A terraced dirt mound, located in the southwest corner of the site, was constructed prior to 1987 as part of a feasibility study for the revegetation of burial grounds. It was terraced to determine the minimum soil depth required to sustain plant growth.

This waste site has an HRS Migration score of 1.84 (Stenner et al. 1988).

2.1.3.6.4 118-D-2 (100-D) Burial Ground No. 2. The 118-D-2 Burial Ground No. 2 is an inactive solid waste site that operated from 1949-1970. This burial ground is located about 2,700 ft southwest of the 105-DR Building (PNL 1991). It received an estimated 10,000 m^3 of miscellaneous contaminated solid waste, irradiated dummies, splines, rods, thimbles, and gun barrels. Beginning in April 1966, low-level radioactive solid waste from the 100 N Area was also buried at this site.

The 118-D-2 site (1,000 ft x 357 ft x 20 ft) contained many trenches oriented in an east-west direction and five disposal pits (Stenner et al. 1988). The trenches are 66 ft wide at the surface, 20 ft wide at the bottom and 20 ft deep. Each disposal site is composed of two small pits, constructed with railroad ties, having interior dimensions of approximately 6 ft x 6 ft, placed within an excavation 24 ft x 24 ft deep. All of the trenches and disposal pits were covered with 6 ft of soil.

The radionuclide inventory for the 118-D-2 Burial Ground No. 2, decayed through April 1, 1986, was reported by Stenner et al. (1988) as the following:

^{14}Cobalt	6.60E-01 Ci	^{152}Europium	1.63E+01 Ci	^{63}Nickel	9.24E+01 Ci
^{60}Cobalt	8.49E+02 Ci	^{154}Europium	2.79E+01 Ci	^{90}Strontium	1.50E+00 Ci
^{137}Cesium	1.50E+00 Ci	^{3}Hydrogen	3.50E+00 Ci		

Estimates of metallic waste disposed of at this burial ground are as follows (Stenner et al. 1988):

Aluminum Tubes:		16,3290 kg
Aluminum Spacers:		36,287 kg
Lead-Cadmium Poison Slugs:		
	Lead:	89,040 kg
	Cadmium:	3,719 kg
Graphite:		54 kg
Desiccant:		14 kg
Aluminum Poison Slugs:		5,987 kg
Boron Poison Slugs:		816 kg
Lead:		58,966 kg
Mercury:		0 kg
Miscellaneous Metallic Waste:		16,329 kg

Site personnel report that there was a large fire in this burial ground sometime around 1960. Much of the burial ground surface is situated about one foot above the grade of the surrounding area.

This waste site has an HRS Migration score of 2.76 (Stenner et al. 1988).

2.1.3.6.5 118-D-3 (100-D) Burial Ground No. 3. The 118-D-3 Burial Ground No. 3 is an inactive solid waste site that operated from 1956 to 1973. This burial ground is located approximately 350 ft east of the 105-DR Building (PNL 1991). It received miscellaneous contaminated solid wastes, irradiated dummies, splines, rods, thimbles, and gun barrels.

The 118-D-3 site (1,000 ft x 250 ft) was divided up into five sections to allow grouping of the like-wastes (Hanford Drawing H-1-4046). Typically, the trenches were 200 ft x 20 ft x 20 ft deep and the spacing between the trenches was not uniform (Stenner et al. 1988). The 118-D-3 site also contained a burning pit that was used for the disposal of low-level radioactive combustible waste (Owen 1967). This burial ground received an estimated 100 m^3 of waste. The radionuclide inventory for the 118-D-3 Burial Ground No. 3, decayed through April 1, 1986, was reported by Stenner et al. (1988) to include the following:

^{58}Cobalt	6.60E-01 Ci	^{152}Europium	1.47E+01 Ci	^{63}Nickel	5.18E+01 Ci
^{60}Cobalt	5.90E+02 Ci	^{154}Europium	2.64E+01 Ci	^{90}Strontium	1.13E+00 Ci
^{137}Cesium	1.130E+00 Ci	^{3}Hydrogen	3.50E+00 Ci		

Estimates of metallic waste disposed of at this burial ground are as follows (Stenner et al. 1988):

Aluminum Tubes:		16,329 kg
Aluminum Spacers:		36,287 kg
Lead-Cadmium Poison Slugs:		
	Lead:	89,040 kg
	Cadmium:	3,719 kg
Graphite:		54 kg
Desiccant:		14 kg
Aluminum Poison Slugs:		5,987 kg
Boron Poison Slugs:		816 kg
Lead:		58,966 kg
Mercury:		0 kg
Miscellaneous Metallic Waste:		16,329 kg

The 118-D-3 was also used for the disposal of 100 N Area solid waste, thus extending the eastern boundary.

Additional solid waste buried in or very near this burial ground are included as a part of this waste site. A short summary of the additional burial grounds follows:

- Minor Construction Burial Ground No. 2 was a trench dug in 1953 to receive contaminated thimbles, rod guides, and miscellaneous waste removed from the 105-DR Reactor during an extended Ball 3X outage. The contaminated wastes were covered with six feet of dirt and the location was marked with cement monuments (Heid 1956), however, the monuments are now absent.

- A small trench was dug in March 1954 to receive effluent water from the number one DR west effluent expansion box during repairs. It was described as being a "grave" (a trench that was dug to receive a specific waste and covered as soon as the waste was received) (Clukey 1954).

This waste site has an HRS Migration score of 2.76 (Stenner et al. 1988).

2.1.3.6.6 118-D-4 Construction Burial Ground. The 118-D-4 Construction Burial Ground is an inactive solid waste burial site that operated from 1953-1967. This burial ground is located approximately 200 ft southeast of the 105-D Reactor Building (PNL 1991). It received contaminated material (mainly reactor components and hardware) generated from various reactor modifications from the 105-D Reactor Building.

The 118-D-4 site (600 ft x 200 ft x 20 ft) contains many nonuniform trenches (Stenner et al. 1988). The site received an estimated 20,000 m^3 of waste. The radionuclide inventory for the 118-D-4 Construction Burial Ground, decayed through April 1, 1986, was reported by Stenner et al. (1988) as 1.0 Ci of cobalt-60.

The 105-D Ball 3X Burial Ground is considered a part of this site and is located near the northeast corner. Three square concrete markers identify the location (WHC 1991a).

This waste site has an HRS Migration score of 1.84 (Stenner et al. 1988).

2.1.3.6.7 118-DR-1 (105-DR) Gas Loop Burial Ground. The 118-DR-1 Gas Loop Burial Ground is an inactive solid waste site that operated from 1963 to 1964. This waste site is located 600 ft south of the 105-DR Building (PNL 1991). It received irradiated metal assemblies from the 105-DR gas loop.

The 118-DR-1 site (125 ft x 74 ft x 15 ft) contains a single north-south trench that was originally a gunnite-lined pool. The pool was used to perform examinations and sectioning of test assemblies. This site received an estimated 20 m^3 of metallic waste. The radionuclide inventory for the 118-DR-1 Gas Loop Burial Ground, decayed through April 1, 1986, was reported by Stenner et al. (1988) as 1.0 Ci of cobalt-60. Support structures for the former test assembly removal pipe are still in place at the north and south ends of the site.

This waste site has an HRS Migration score of 1.84 (Stenner et al. 1988).

2.1.3.6.6 128-D-1 (100-D/DR) Burning Pit. The 128-D-1 Burning Pit is an inactive solid waste site that operated from 1944 to 1967. This site is located at Hanford coordinates N92000, W51000 (Kiser 1988). It received an estimated 40,000 m^3 of nonradioactive combustible materials such as paint waste, office waste, and chemical solvents (Stenner et al. 1988).

This waste site has an HRS Migration score of 0.13 (Stenner et al. 1988).

2.1.3.7 Electrical Facilities. This category includes the transformers, capacitors, switches, and other miscellaneous electrical facilities within the 100-DR-2 Operable Unit. The main substation for the 100 D/DR Area, 151-D, is located within the 100-DR-2 Operable Unit. All PCB transformers on the Hanford Site have been characterized for PCB content and are tracked on a computer file data base. Transformers are inspected regularly, and any leaks are addressed promptly. There is a possibility of PCB-contaminated soil resulting from past-practices, however.

2.1.4 Waste Generation Process

All of the 100-DR-2 Operable Unit waste management units can be grouped into the following categories:

- process liquid waste and sludges
- reactor exhaust stack emissions
- radioactive solid wastes
- sanitary liquid wastes
- nonradioactive solid waste
- other liquid waste
- hazardous waste.

Before discussing the specific waste facility characteristics in Section 2.1.4, these general categories of waste generation processes are described below.

The information presented on waste generation processes at the 100-DR-2 Operable Unit is based on information available at the time of preparation of this work plan. Additional information will be obtained, as needed, during the LFI source data compilation described in Section 5.0.

2.1.4.1 Process Liquid Wastes and Sludges. Process wastes were generated as a result of reactor cooling, reactor and equipment decontamination, and filtration of reactor exhaust stack emissions.

2.1.4.1.1 Reactor Cooling Water System. The DR Reactor used a once-through cooling process in which water from the Columbia River was circulated through the reactor one time and then was discharged back to the river or to the soil column disposal facilities (Dorian and Richards 1978). The cooling water that left the reactor contained radioactive species from the reactor and chemicals that were added to treat the water before its use. Detailed information regarding the physical description of the reactor, its associated water supply, and effluent disposal facilities may be found in the *Hazards Summary Report: Volume 3 - Description of the 100-B, 100-C, 100-D, 100-DR, 100-F, and 100-H Production Reactor Plants* (General Electric 1963).

A detailed summary of the reactor cooling water system is included in Section 2.1.3.1.1 of the 100-DR-1 Operable Unit Work Plan (DOE-RL 1992b).

2.1.4.2 Reactor Exhaust Stack Emissions. The primary ventilation system circulated air through the 118-DR-2 Reactor and then discharged it through the 132-DR-2 (116-DR) Exhaust Stack. In order to control the release of radioactive matter into the atmosphere, a confinement system was installed to filter it for particulates and halogens in the 117-DR Filter Building before exhausting it through the 132-DR-2 Stack.

2.1.4.3 Radioactive Solid Waste. Radioactive solid wastes generated in the 100 D/DR Area consisted mainly of discarded activated metallic reactor parts containing nickel-59, cobalt-60, and nickel-63. Most radioactive solid wastes from the 100 D/DR Area were discarded in burial grounds 118-D-1, 118-D-2, and 118-D-3.

2.1.4.4 Sanitary Wastes. Sanitary wastes from the 100 DR Area were treated in the 1607-D-3 Septic Tank and disposed of in associated tile fields. There are no records of hazardous or radioactive wastes being disposed of in these systems.

2.1.4.5 Nonradioactive Solid Waste. Nonradioactive solid waste generated within the 100 D/DR Area primarily includes decommissioning wastes such as scrap metal, concrete, and other building materials. An inventory has been prepared, and can be found in *Estimates of Solid Waste Burial in 100 Area Burial Grounds* (Miller and Wahlen 1987), that identifies and quantifies the volumes of solid waste disposed within the 100 Area. This inventory is based on historical documents, the reconstruction of operating practices, and the experience of knowledgeable individuals involved in waste disposal practices during the years of reactor operations.

2.1.4.6 Other Liquid Waste. Other liquid waste includes anything nonradioactive or not sanitary related. This category encompasses potential gasoline or oil leaks from underground or aboveground storage tanks, potential PCB contamination of the soil from electrical facilities, and backwash and discharge water from various support facilities.

2.1.4.7 Hazardous Waste. Hazardous wastes generated include herbicides, insecticides, solvents, paints, and other chemicals, either by industrial or support services operations. Specific information on hazardous waste disposal practices at the operable unit is currently unavailable.

2.1.5 Interactions with Other Operable Units

As shown in Figure 2-1, the 100-DR-2 Operable Unit is bordered on the north by the 100-DR-1 and on the east and south by the ~~100-DR-3 Operable Units~~ 100 D Area perimeter road. The 100-HR-3 Operable Unit (the groundwater unit) underlies the entire area between the 100 D/DR and 100 H Areas. Information gained from CMS/FS work at the 100-DR-1 and 100-HR-3 Operable Units will be used as much as possible to guide activities at the 100-DR-2 Operable Unit.

The RFI/CMS and remedial investigation/feasibility study (RI/FS) activities to be performed at other operable units at the Hanford Site 100 Area will also be integrated with the work in the 100-DR-2 Operable Unit. Operable units for which work plans have been approved and work is under way are: 100-BC-1, 100-BC-5, 100-DR-1, 100-FR-1, 100-FR-3, 100-HR-1, 100-HR-3, 100-KR-1, 100-KR-4, 100-NR-1, and 100-NR-2. Information gathered at each operable unit will be evaluated for relevance by investigators at other operable units and used where appropriate.

2.1.6 Interactions with the Resource Conservation and Recovery Act of 1976

According to Appendix B of the Hanford Federal Facility Agreement and Consent Order Action Plan (Ecology et al. 1990a), the 100-DR-2 Operable Unit contains one waste storage and treatment facility subject to permitting and/or closure as a TSD facility under RCRA; the 122-DR-1 Sodium Fire Facility. The 100-DR-2 and 100-HR-3 Operable Unit RFI/CMS coordinators and the 122-DR-1 Sodium Fire Facility RCRA closure coordinators will work to satisfy all regulatory requirements and avoid duplication of efforts.

2.2 OPERABLE UNIT SETTING

This section discusses the physical setting of the 100-DR-2 Operable Unit, including topography, geology, hydrogeology, surface hydrology, meteorology, environmental resources, and human resources. The discussion is general in nature for the entire 100 D/DR Area. Information describing the physical setting of the 100-DR-2 Operable Unit can be found in Section 2.2 of the 100-DR-1 Operable Unit Work Plan (DOE-RL 1992b). Specific subsections in the referenced Section 2.2 include:

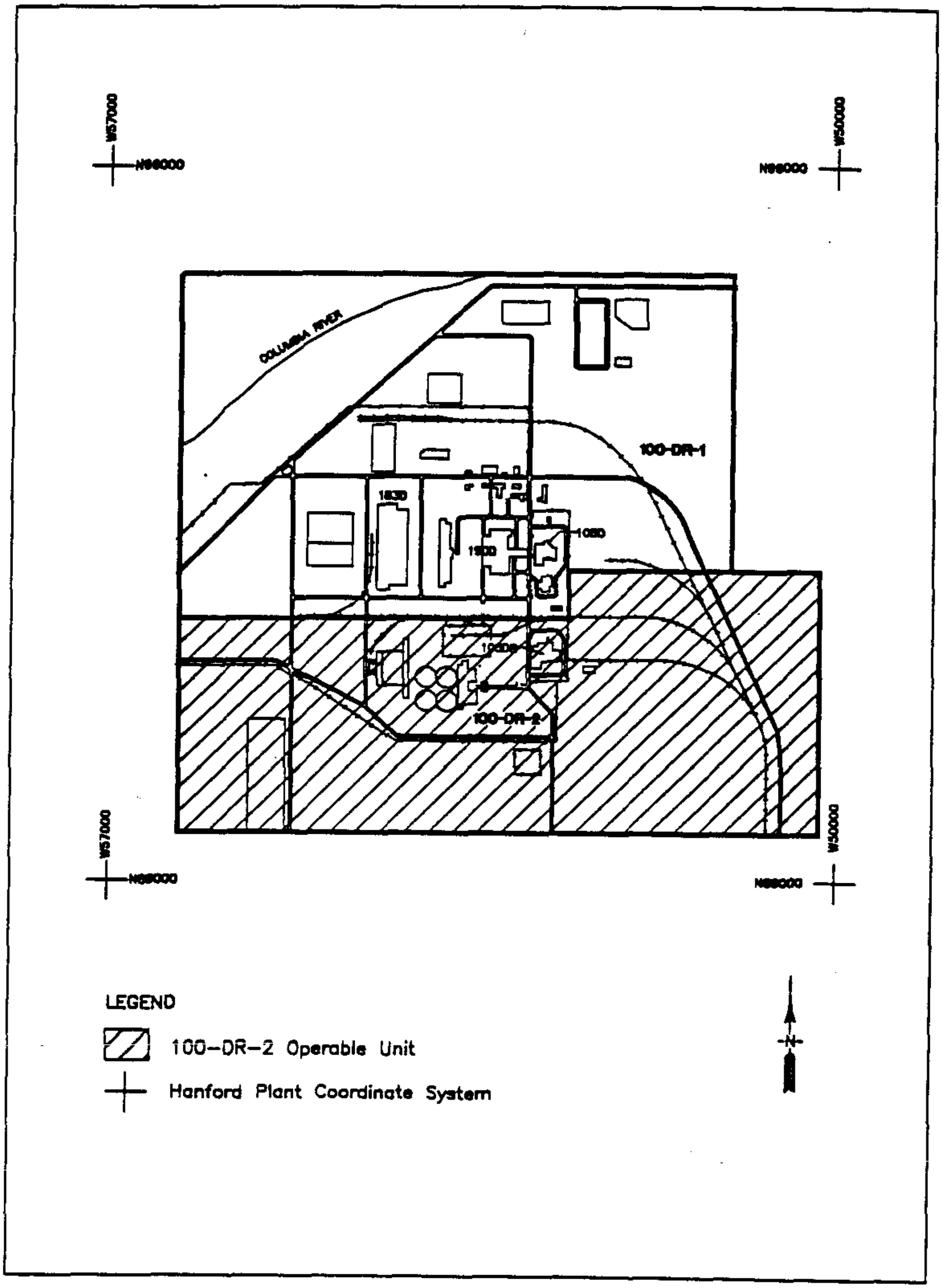
- Section 2.2.1 Topography
- Section 2.2.2 Geology
- Section 2.2.3 Hydrogeology
- Section 2.2.4 Surface Hydrology
- Section 2.2.5 Meteorology
- Section 2.2.6 Environmental Resources
- Section 2.2.7 Human Resources.

Figures 2-3 through 2-9 are included to present a condensed form of the material referenced from the 100-DR-1 Work Plan. Figure 2-3 is a topographic map of the 100 D/DR and surrounding area. Figure 2-4 presents a general stratigraphic cross-section of 100 D/DR Area (the vadose zone geology, as determined from the *100-DR-1 Operable Unit Limited Field Investigation Report* [DOE-RL 1993a] boring logs, support the generalized vadose zone geology as depicted in Figure 2-4). Figure 2-5 shows water-table contours. Figure 2-6 illustrates a generalized hydrostratigraphic column for 100 D/DR Area. And Figure 2-7 depicts wind patterns across the Hanford Site. Figure 2-8 shows the surface of the Saddle Mountain Basalt Formation near the 100 D/DR Area. Figure 2-9 shows a geologic cross-section across the western Wahluke Syncline in the vicinity of the 100 D/DR Area.

The geology of the Hanford Site has been investigated in detail as a part of siting studies for the use of the 200 West Area as a deep geologic repository for high-level nuclear waste. *Geologic Studies of the Columbia Plateau: A Status Report* (Myers et al. 1979) describes the regional geologic studies performed between 1977 and 1979 in support of this program; the *Site Characterization Plan, Reference Repository Location, Hanford Site, Washington; Consultation Draft* (DOE 1988) describes much of the geologic information of the area (with emphasis on the 200 West Area). Geologic data were also obtained from recent stratigraphic studies of the Hanford Site from *Revised Stratigraphy for the Ringold*

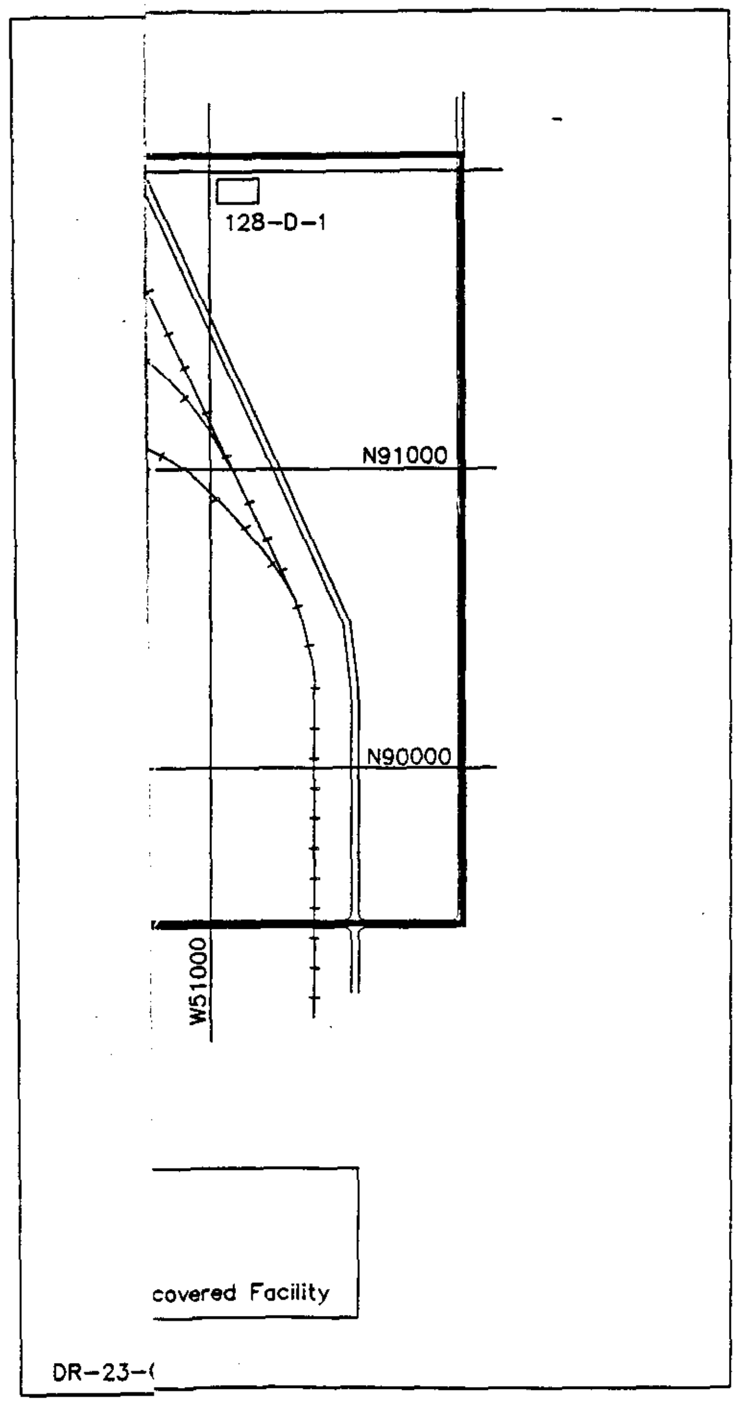
Formation, Hanford Site, South Central Washington (Lindsey 1991), and *Geology and Hydrology of the Hanford Site: A Standardized Text for Use in Westinghouse Hanford Company Documents and Reports* (Delaney et al. 1991). A detailed discussion of the groundwater beneath the 100-DR-2 Operable Unit can be found in Section 2.2.3 of the 100-HR-3 Operable Unit Work Plan (DOE-RL 1992a). Meteorological data have been collected at the Hanford Meteorological Station since 1945. Before that time, data were available from a U.S. Weather Bureau station 10 miles away. *Climatological Summary for the Hanford Area* (Stone et al. 1983) and the *Final Environmental Impact Statement - Disposal of Hanford Defense High-Level, Transuranic, and Tank Wastes* (DOE 1987) summarize much of this data.

Figure 2-1 The 100 D/DR Operable Unit



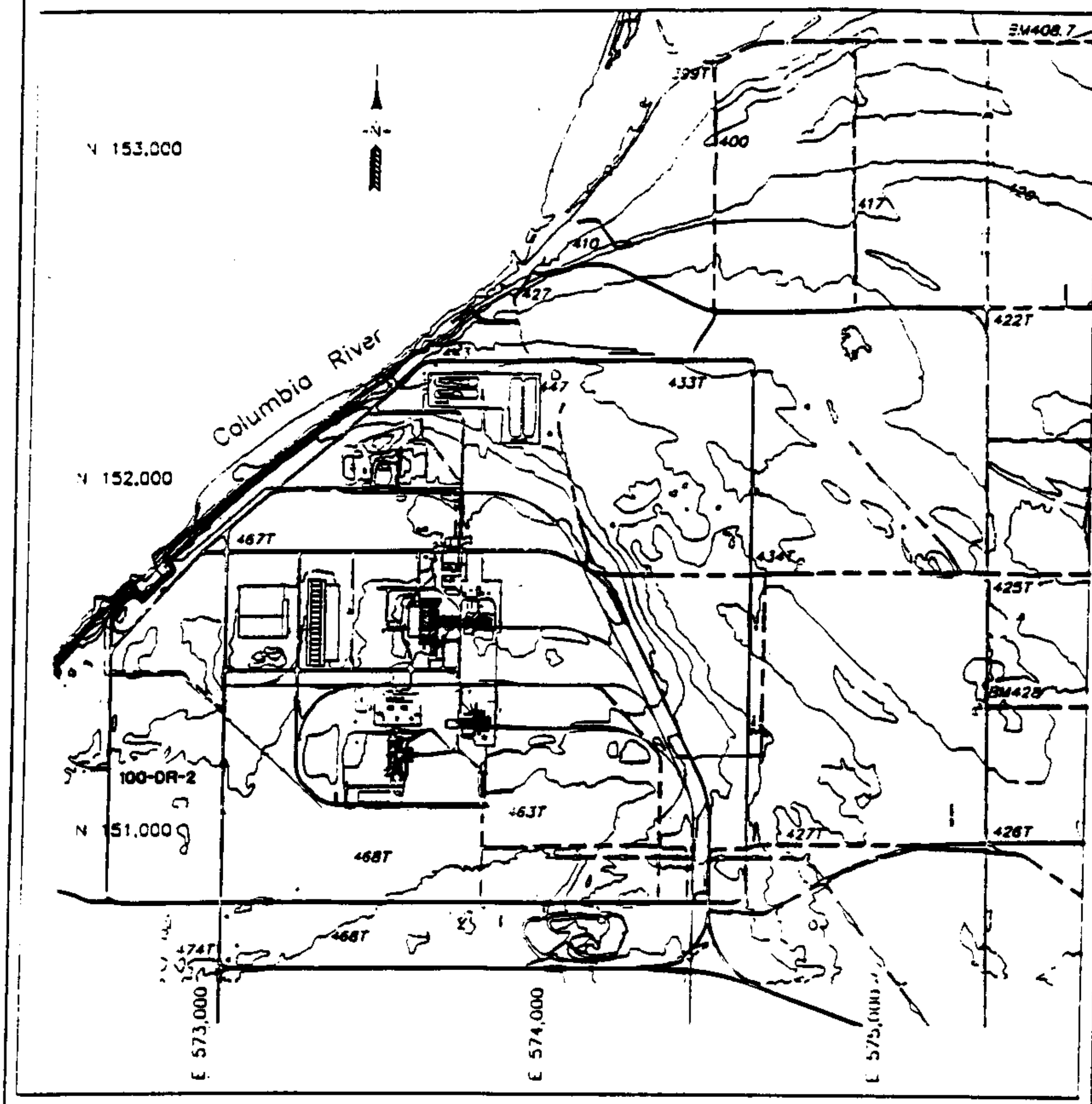
THIS PAGE INTENTIONALLY
LEFT BLANK

Figure 2-2 100-DR-2 Operable Unit



THIS PAGE INTENTIONALLY
LEFT BLANK

Figure 2-3 Topographic Map



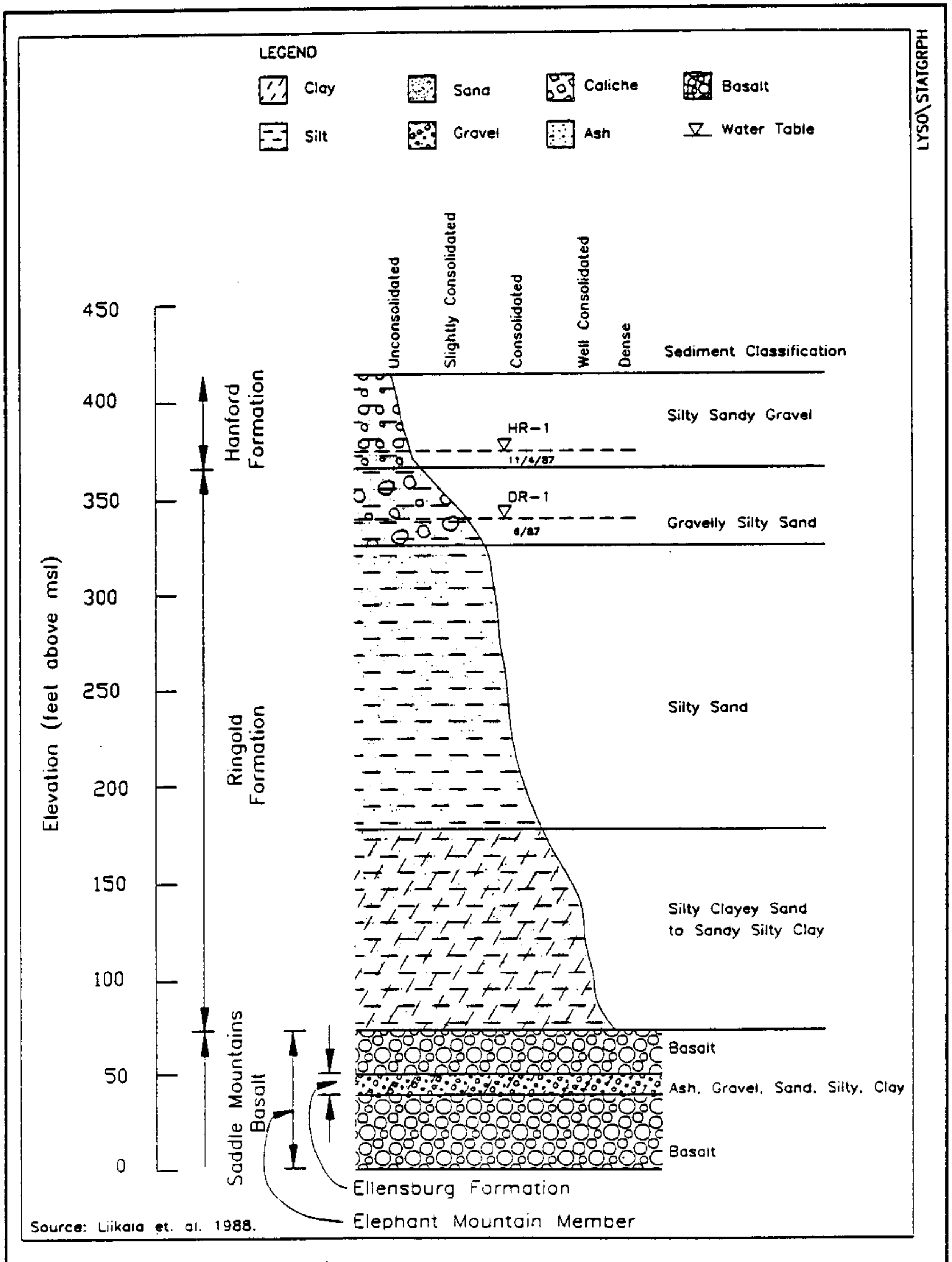
Elevation in feet (National Geodetic Vertical Datum)
Contour interval = 10 feet

0 600 Meters
0 2000 Feet

Modified from: USGS 1986.

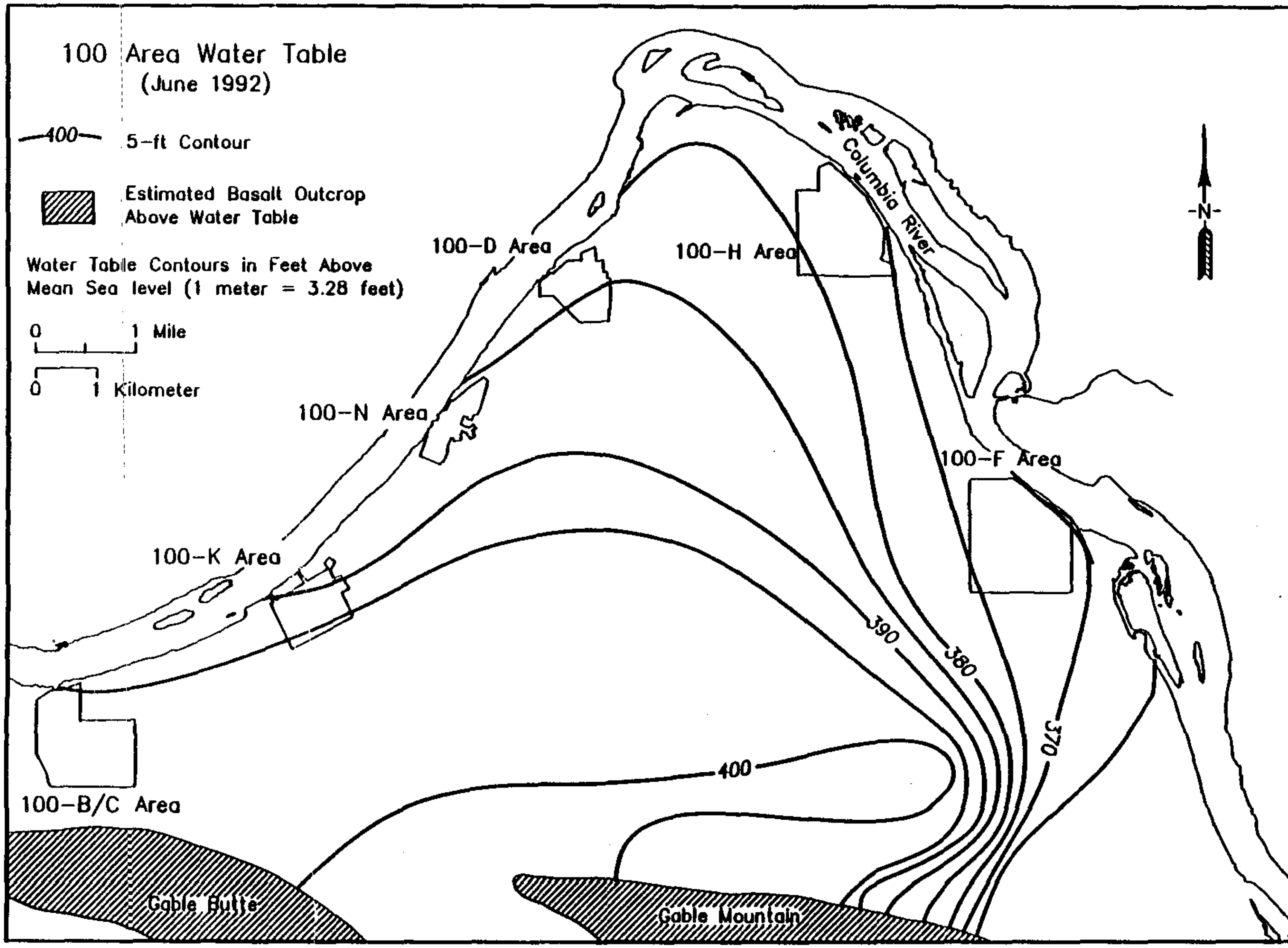
THIS PAGE INTENTIONALLY
LEFT BLANK

Figure 2-4 Generalized Stratigraphic Column for the 100 H Area, Assumed to be Similar in the 100 D/DR Area



THIS PAGE INTENTIONALLY
LEFT BLANK

9413296.1661

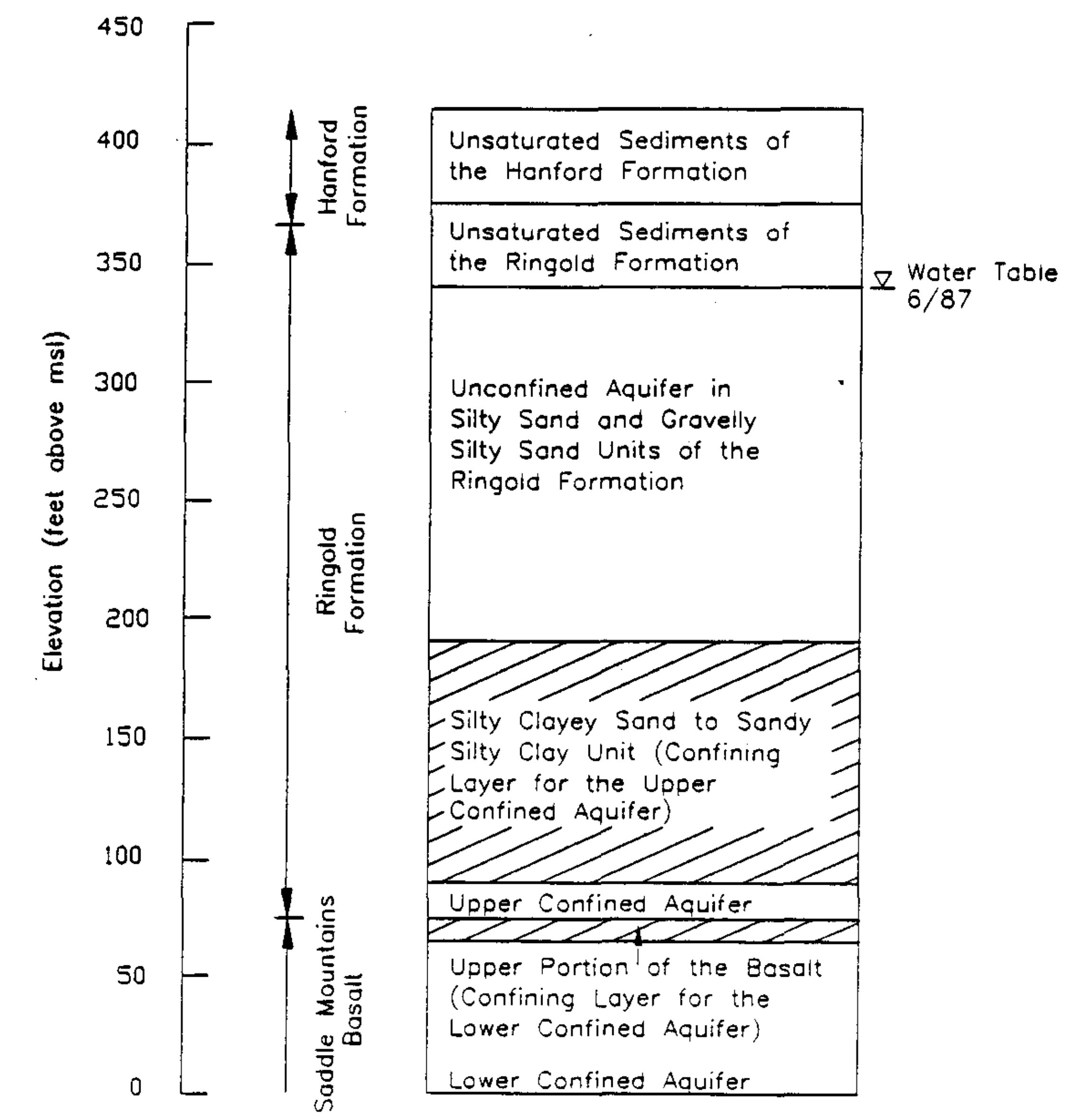


NAH\060193-A

Figure 2-5 Water Table Elevations for June 1987

THIS PAGE INTENTIONALLY LEFT BLANK

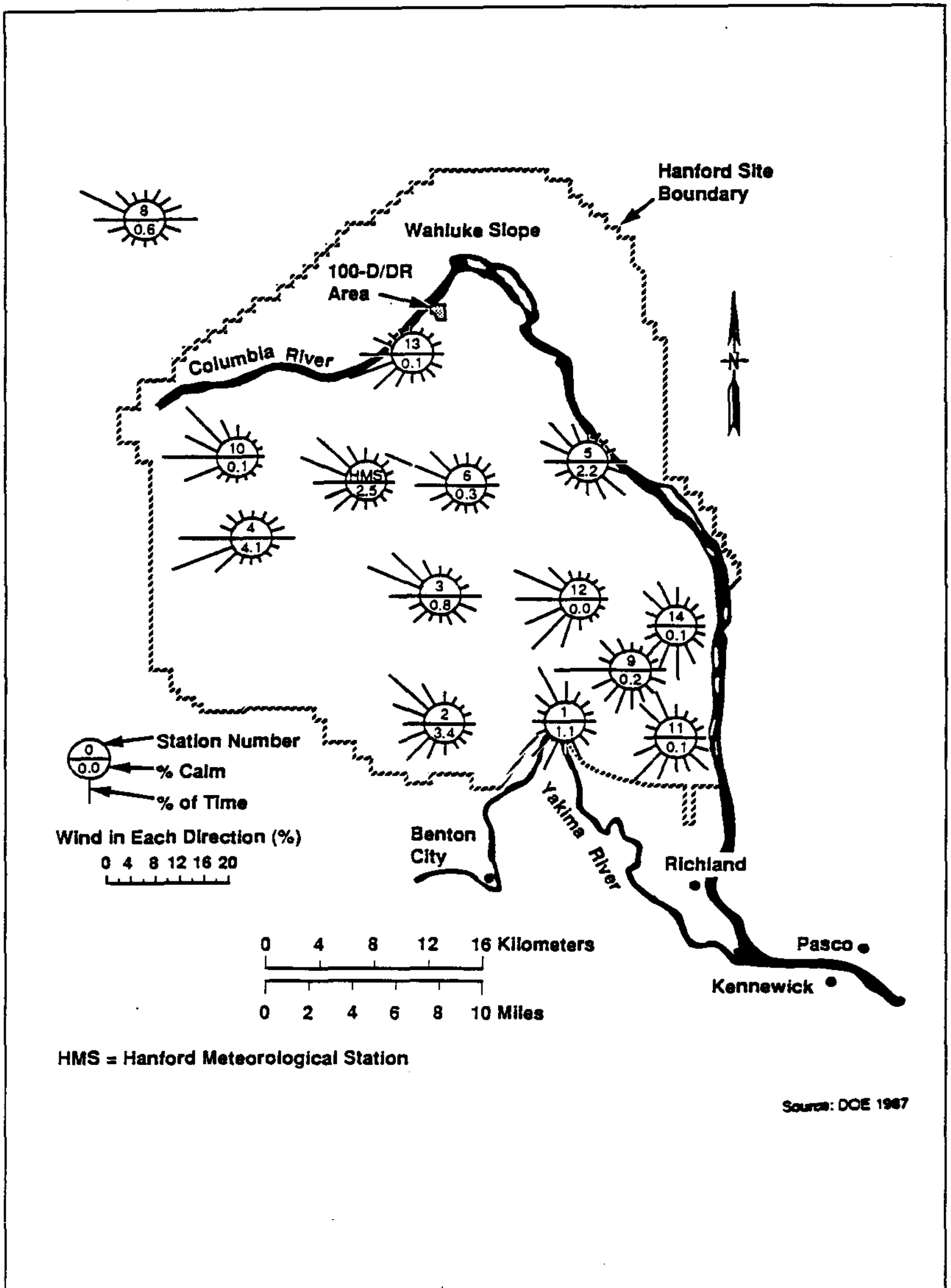
Figure 2-6 Conceptual Hydrostratigraphic Column Assumed for the 100 D/DR Area, Based on 100 D/DR Area Well Data



Source: Liikala et. al. 1988

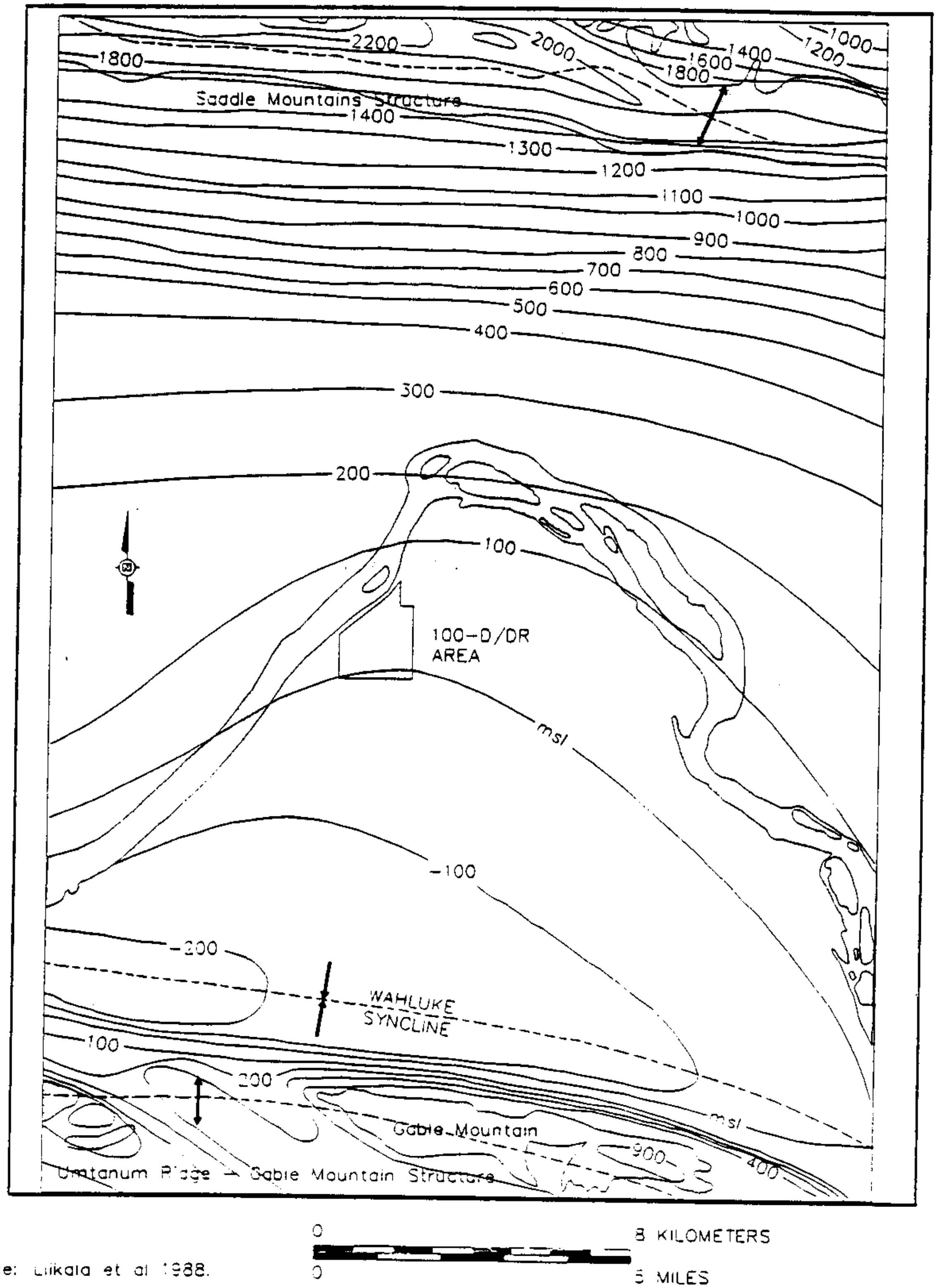
THIS PAGE INTENTIONALLY LEFT BLANK

Figure 2-7 Wind Roses for the Hanford Telemetry Network, 1979-1982



THIS PAGE INTENTIONALLY
LEFT BLANK

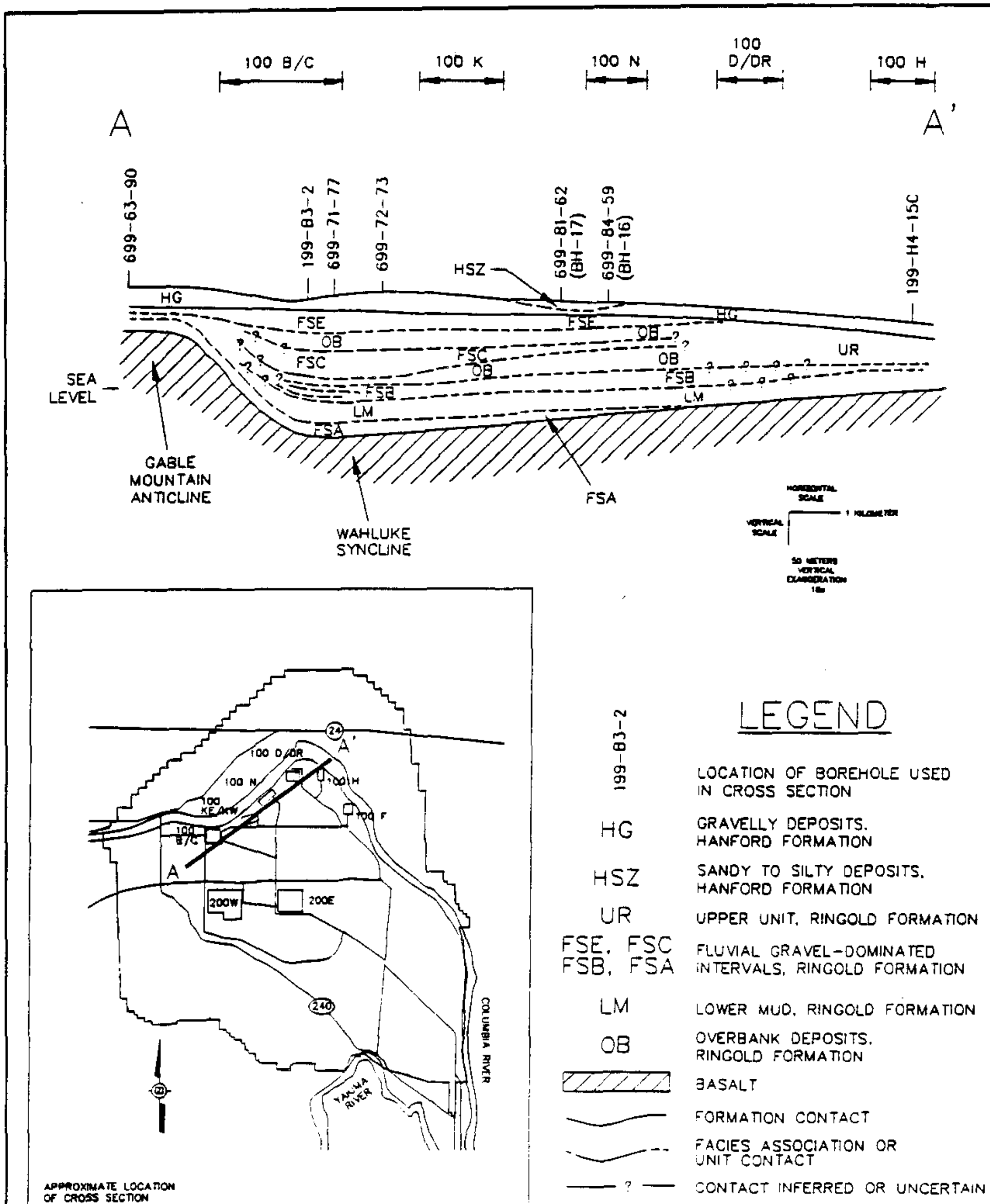
Figure 2-8 Surface of the Saddle Mountains Basalt Formation Near the 100 D/DR Area (Contours in Feet Above or Below Mean Sea Level)



Source: Liikala et al 1988.

THIS PAGE INTENTIONALLY
LEFT BLANK

Figure 2-9 Northeast to Southwest Geological Sediments Across the Western Wahluke Syncline in the Vicinity of the 100 B/C, 100 K, 100 N, 100 D/DR, and 100 H Areas of the Hanford Site



SOURCE: LINDSEY 1991.

THIS PAGE INTENTIONALLY
LEFT BLANK

Table 2-1 Waste Transfer, Treatment, Storage, Disposal, and Related Facilities in the 100-DR-2 Operable Unit Area (Page 1 of 5)

[a]Current Designation (Alias Designation)	Name	Years in Service/Status	Facility Description/Purpose	Waste Received or Handled
[c]	Sodium Dichromate/Acid Pumping Station	[b]Inactive	Transported solutions from the pump station to storage tanks located at 185-D and outside 190-DR.	Unknown volume of solutions was transported from the pump stations.
[c]	Furnace	[b]In storage at site not part of any operation.		
[c]	Alum Storage Tank	[b]In storage at site not part of any operation.		
[c]	Temporary Garage and Gasoline Dispensing Station	Unknown-1950[b]	Temporary garage facility used during the construction of the water treatment facilities for the 118-DR-6 Reactor.	
151-D	Main Substation	Active	Main substation for 100 D/DR Area	Polychlorinated biphenyls associated with the electrical facilities.
116-DR-3 (105-DR)	Storage Basin Trench	1955/Inactive	Unlined trench 60 ft x 40 ft x 10 ft deep. Contaminated sludge and water removed from the 105-DR Fuel Storage Basin was placed in this trench.	Received 4,000,000 L of contaminated sludge and water from the 105-DR Fuel Storage Basin.
116-DR-4 (105-DR)	Pluto Crib	1950-1956/Inactive	Crib 10 ft x 10 ft x 10 ft deep. Located 200 ft southeast of the 118-DR-6 building and 40 ft northeast of the 116-DR-3. Received liquid wastes isolated from tubes containing ruptured fuel elements in the 118-DR-6 Reactor.	Received 4,000 L of liquid wastes isolated from tubes containing ruptured fuel elements in the 105-DR Reactor. Handled an estimated 0.0088 lb of sodium dichromate.
116-DR-6 (1608-DR)	Liquid Disposal Trench	1953-1965/Inactive	Unlined trench 50 ft x 10 ft x 10 ft deep. Received coolant that was diverted to the trench during the Ball 3X upgrade.	Received coolant that was diverted to the trench during the Ball 3X upgrade. It also received diverted water when maintenance on the effluent system was necessary. An estimated 7,000,000 L of waste effluents were received, including 4.4 lb of sodium dichromate.

Table 2-1 Waste Transfer, Treatment, Storage, Disposal, and Related Facilities in the 100-DR-2 Operable Unit Area (Page 2 of 5)

[a]Current Designation (Alias Designation)	Name	Years in Service/Status	Facility Description/Purpose	Waste Received or Handled
116-DR-7 (105-DR)	Inkwell Crib	1953/Inactive	Unlined crib, 5 ft x 5 ft x 10 ft deep. Registered underground injection well. Was used to receive the liquid potassium borate solution that was drained from the 3X System prior to the Ball 3X System upgrade. It may be a tank rather than a crib.	Received approximately 6,600 lb of potassium borate, plus 4,000 L of liquid potassium borate.
116-DR-8 (105-DR)	Seal Pit Crib	1960-1964(reactor operations) 1972-1986/Inactive	Unlined crib 10 ft x 10 ft x 10 ft deep. Purpose was to receive liquid wastes from the containment system 117-DR Building Seal Pit.	Received an estimated 240,000 L of liquid waste from the containment system 117-DR Building Seal Pit.
116-DR-10	Fuel Storage Basin Cleanout Percolation	Inactive; October 1984-November 1984	Inactive liquid waste site that has been decommissioned. This facility received processed water from the 105-DR Fuel Storage Basin.	Handled processed shielding water from the 105-DR Fuel Storage Basin.
116-D-8 (100-D)	Cask Storage Pad	1946-1975/Inactive	Solid waste site used to store shipping and handling casks. The cask pad is a concrete pad with two drains. One of the drains facilitated rain runoff and the disposal of minor decontamination solutions. The second drain was for decontamination use and emptied into a french drain.	Stored shipping and handling casks.
117-DR	Filter Building	Unknown-1960/ Inactive[b]	Reinforced concrete structure, almost completely below grade. Filter ventilation air from the confinement zone of the DR Reactor before discharge through the ventilation stack.	Filter reactor exhaust air.
118-DR-1	105-Gas Loop Burial Ground	1963-1964/Inactive	This site contains a single north-south trench that was originally a gunnite-lined pool. The site dimensions are 125 ft x 75 ft x 15 ft deep.	Received irradiated metal assemblies from the 105-DR Gas Loop.

Table 2-1 Waste Transfer, Treatment, Storage, Disposal, and Related Facilities in the 100-DR-2 Operable Unit Area (Page 3 of 5)

*Current Designation (Alias Designation)	Name	Years in Service/Status	Facility Description/Purpose	Waste Received or Handled
118-DR-2 (105-DR)	Reactor Building	1950-1964/Inactive	Consists of reactor block, graphite moderator stack, biological and thermal shields, process tubes, the safety and control systems, the irradiated fuel storage basin, and contaminated portions of reactor buildings.	House the reactor core.
118-D-1 (100-D)	Burial Ground No. 1	1944-1967/Inactive	Many trenches running north-south. Typically, the trenches were 300 ft x 20 ft x 20 ft with a 20 ft space between them. The burial ground is 450 ft x 350 ft x 20 ft.	Received irradiated reactor parts, dummies, thimbles, rods, gun barrels and other contaminated solid waste.
118-D-2 (100-D)	Burial Ground No. 2	1949-1970/Inactive	Many trenches running east-west and five disposal pits. The trenches are 66 ft wide at the surface, 20 ft wide at the bottom and 20 ft deep. Each disposal pit is composed of 2 small pits, constructed with railroad ties, with interior dimensions of about 6 ft x 6 ft, placed within an excavation 24 ft x 24 ft. The burial ground is 1,000 ft x 357 ft x 20 ft deep.	Received miscellaneous contaminated solid waste, irradiated dummies, splines, rods, thimbles, and gun barrels.
118-D-3 (100-D)	Burial Ground No. 3	1956-1973/Inactive	Many trenches, 200 ft x 20 ft x 20 ft, nonuniform spacing. It also contained a burning pit for disposal of low-level radioactive combustible waste.	Received miscellaneous contaminated solid waste and irradiated dummies, splines, rods, thimbles, and gun barrels.
118-D-4	Construction Burial Ground	1953-1967/Inactive	This site contained many nonuniform trenches. The overall dimensions are 600 ft x 200 ft x 20 ft deep. The Ball 3X Burial Ground is considered a part of this site.	Received contaminated material (mainly reactor components and hardware) generated during various reactor modifications from the 105-D Reactor Building.

9413296.1669

Table 2-1 Waste Transfer, Treatment, Storage, Disposal, and Related Facilities in the 100-DR-2 Operable Unit Area (Page 4 of 5)

*Current Designation (Alias Designation)	Name	Years in Service/Status	Facility Description/Purpose	Waste Received or Handled
118-D-5 (Ball 3X)	Burial Ground	1954/Inactive	Two parallel burial trenches with one trench on each side of the existing experimental level-one discharge pipe. Each trench is 40 ft x 20 ft x 10 ft deep. It has also been described as being a 20 ft x 20 ft x 10 ft deep single trench.	Received thimbles removed from the 105-DR Reactor during the Ball 3X upgrade project.
122-DR-1 (105-DR)	Sodium Fire Facility	1972-1986	Inactive liquid waste site located in the supply and exhaust fan wing of the 105-DR Reactor Building. Facility was used for thermal testing and treatment of sodium and other alkali metals.	Handled wastes consisting of sodium, lithium, and sodium-potassium alloy. Approximately 20,000 Kg were managed at this facility each year. It also used to store up to 20,000 L of dangerous waste.
126-DR-1 (190-DR)	Clearwell Tank Pit	1970's-present Demolished tanks, pit still remains.	Excavated area located between the 183-DR and 190-DR facilities that received demolition and inert waste.	
128-D-1	100-D/DR Burning Pit	1944-1967/Inactive	This site is 100 ft x 100 ft x 10 ft deep.	Received nonradioactive combustible materials such as paint waste, office waste and chemical solvents.
132-DR-1 (1608-DR)	Waste Water Pumping Station	1950-1964/Inactive	Inactive liquid waste site that has been decommissioned. This facility received water from reactor building drains containing low-level radionuclides and decontamination chemicals.	Handled water from reactor building drains containing trace amounts of low-level radionuclides and decontamination chemicals. Radionuclides were primarily miscellaneous fission and activation products. The decontamination chemicals consisted of sodium fluoride, oxalic acid, and citric acid.

Table 2-1 Waste Transfer, Treatment, Storage, Disposal, and Related Facilities in the 100-DR-2 Operable Unit Area (Page 5 of 5)

[a]Current Designation (Alias Designation)	Name	Years in Service/Status	Facility Description/Purpose	Waste Received or Handled
132-DR-2 (116-DR)	Reactor Exhaust Stack	1950-1986/Inactive	Monolithic, reinforced concrete structure with a maximum wall thickness of 1.5 ft at the base. Exhaust ventilation air and gas from the DR Reactor.	Interior of stack contains radioactive materials from the reactor exhaust air.
183-DR	Filter Plant, Head House, Sedimentation and Coagulation Basin	1950-1964?/ Demolished	Supplied treated cooling water to the 105-DR Reactor. Housed water treatment and filtering facilities.	
190-DR	Main Pump House	1950-1964?/ Inactive	Included four steel tanks with a storage capacity of 5 million gal each. Provide primary cooling water for 105-DR Reactor. Treated water with sodium dichromate prior to releasing it to the 105-DR Reactor.	
1702-DR	Exclusion Area Badge House	Inactive	Badge House located northwest of the 105-DR Reactor. This facility provided entry into the exclusion zone.	
1607-D-1	Septic Tanks and Associated Drain Field	[b]Inactive	One septic tank drain system that supported the 1701-D and 1709-D facilities.	Handled sanitary wastes.
1607-D-3	Septic Tanks and Associated Drain Field	Active	One septic tank drain system that supports the 151-D Electrical Substation.	Handles sanitary wastes.

Sources: Dorian and Richards (1978), General Electric (1963), and Miller and Wahlen (1987).

[a]Waste Information Data System (WIDS) (DOE-RL 1991b).
[b]No information currently available.
[c]No site designation number.

THIS PAGE INTENTIONALLY
LEFT BLANK

3.0 INITIAL EVALUATION

This chapter provides an initial evaluation of contamination in the 100-DR-2 Operable Unit. It includes a summary of available information on contaminants, an evaluation of potential ARAR, a preliminary site conceptual model of contaminant transport, and an evaluation of the potential impacts to human health and the environment.

3.1 KNOWN AND SUSPECTED CONTAMINATION

Aside from recent LFI in the 100-DR-1 and 100-HR-3 Operable Units, the most current knowledge of radioactive contamination in the 100 Areas is based on Dorian and Richards (1978), who sampled many of the facilities in 100-DR-2 and other operable units in the 100 Areas. The most substantial potential environmental threats from the 100-DR-2 Operable Unit come from contaminants leaching from area soils into groundwater. These contaminants can subsequently be transported to the Columbia River. Because of the source and groundwater operable unit division, preliminary remedial action objectives for the 100-DR-2 Operable Unit focus on preventing further contamination of groundwater.

An important consideration throughout this discussion is that previous sampling efforts in the 100 D/DR Area have focused on characterizing radiological contamination with little or no sampling for hazardous chemical contaminants. Some historical data on the general use of organic and inorganic chemicals are available, but quantification of nonradioactive contaminant species has been minimal. The recent investigations in the 100-DR-1 Operable Unit (DOE-RL 1993a) should provide useful data to the investigations in the 100-DR-2 Operable Unit, especially in regards to the analogous facility approach. The data will be reviewed and incorporated as appropriate.

Much of the available data related to the 100-DR-2 Operable Unit are presented and evaluated in Chapter 2; therefore, the goal here is to describe the contaminants of concern as a whole, based on information presented in Chapter 2. However, data investigation and evaluation will be conducted as part of the LFI. Data from the 100 D/DR Area source data compilation will be used as appropriate and supplemented with new information generated by the 100-DR-2 investigations. Groundwater, surface water, river sediments, and biota investigations can be referenced in Sections 3.1.3, 3.1.4, and 3.1.6, respectively, of the 100-HR-3 Operable Unit work plan (DOE-RL 1992a). Air investigations can be referenced in Section 3.1.5 of the 100-DR-1 Operable Unit work plan (DOE-RL 1992b).

3.1.1 Sources

The 100-DR-2 Operable Unit includes sources generated from the operation of the DR Reactor and its ancillary facilities. These sources have been described in Section 2.1.3, and the waste generating processes have been described in Section 2.1.4. Figure 2-2 shows the approximate location of the waste units (116-D-8, 116-DR-3, 116-DR-4, 116-DR-6, 116-DR-7, 116-DR-8, 132-DR-1, 118-D-5, 126-DR-1, Sodium Dichromate/Acid Pumping

Station, 1607-D-3, 118-DR-2, 132-DR-2, 118-D-1, 118-D-2, 118-D-3, 118-D-4, 118-DR-1, 128-D-1, and 1607-D-1). Facilities (existing and demolished) that are not considered potential waste units: 1702-DR, 183-DR, 190-DR, 151-D, 126-DR-1, 122-DR-1 (122-DR-1 is being addressed under the RCRA program), are also shown on Figure 2-2.

A primary reference for radiological characterization of the 100-DR-2 Operable Unit sources is a sampling study of the 100 Areas performed during 1975/1976 by Dorian and Richards (1978), which has served as a reference document for the HRS evaluation of the Hanford Site (Stenner et al. 1988), the WIDS database (WHC 1991a) maintained by the WHC, and this work plan. It should be noted, however, that only concentrations and inventories of selected radionuclides were reported in the 1975/1976 study. In particular, nickel-63, which is generally present at activities on the same order of magnitude as cobalt-60, was reported for only some samples; and daughter product radionuclides of strontium-90 and cesium-137 were not included in summaries of total activity. A secondary reference for radiological characterization of the 100-DR-2 Operable Unit (via analogous sites) is the draft report for the 100-DR-1 LFI (DOE-RL 1992b).

3.1.2 Soil

Except for routine process effluent, most wastes generated during operation of the DR Reactor were intentionally disposed into the 100-DR-1 and 100-DR-2 Operable Unit soils. In addition, the piping associated with the process effluent system is known to have leaked into soils of the 100 D/DR Area.

3.1.2.1 Background Soil Quality. There are no background soil data available specifically for the 100-DR-2 Operable Unit. However, a Low Background survey was conducted to establish baseline radiological background conditions in a designated test plot adjacent to the 100 D Area. The radiological data collected during this survey is considered representative of the undisturbed soil surfaces in the 100 Areas of the Hanford Site. The results of this survey are in Appendix C. Surface soil samples are collected periodically at a number of locations to determine the extent of contamination both on and off the Hanford Site as part of the Hanford Environmental Monitoring Program and the analytical results can be found in the *Environmental Monitoring at Hanford for 1987* (Jaquish and Mitchell 1988) and the *Hanford Site Environmental Report for Calendar Year 1989* (Jaquish and Bryce 1990). These samples are of limited utility because they do not provide subsurface soil data, are only analyzed for a limited range of radionuclides, and are purposely located in areas where radionuclide levels are most easily detected. Onsite samples are collected at locations adjacent to major operating facilities, whereas offsite samples are collected around the Hanford Site perimeter, generally in a downwind direction. Because of the intentional proximity to operating facilities, onsite samples may not be regarded as providing an adequate background concentration reference point. Figure 3-1 shows the locations of these sampling stations. Data from both onsite and offsite samples collected in 1988 are presented in Table 3-1. A background soil study was conducted, the *Hanford Site Background: Part 1 Soil Background for Nonradioactive Analytes*, (DOE-RL 1993c) that analyzed soil samples for inorganic constituents. The results of that study are available in Table 3-1 of that report.

The composition of naturally occurring soils in the vadose zone of the Hanford Site has been determined for nonradioactive inorganic and organic analytes in accordance with EPA analysis methods. This work is in support of the Tri-Party Agreement Milestone M-28-00, which states "Submit all soils and groundwater background determination documents to EPA and Ecology."

As a result of the background samples analyzed, comparisons for the correlation coefficient (goodness of fit) and several percentiles (80, 90, and 95), as well as the upper tolerance intervals associated with each percentile, have been formulated. The 95% upper threshold limit (UTL) for inorganic analytes from a lognormal distribution of the data are presented in Table 3-2.

3.1.2.2 Soil Contamination. One surface soil sampling station located outside the southwestern margin of the 100 D/DR Area is sampled as part of the Pacific Northwest Laboratory (PNL) environmental monitoring program at the Hanford Site (Jaquish and Mitchell 1988). Samples analyzed for gamma-emitting radionuclides (uranium, strontium-90, and plutonium-239/240) show, in general, radionuclide concentrations that are low when compared to onsite average concentrations, but are higher than offsite concentrations.

3.1.3 Groundwater

A substantial amount of information is available on the quality of the groundwater in the 100 D/DR Area. The known nature and extent of groundwater contamination in the vicinity of the 100-DR-2 Operable Unit is discussed in detail in Section 3.1.3 of the 100-HR-3 Operable Unit Work Plan (DOE-RL 1992a).

3.1.4 Surface Water and Sediment

The known and suspected nature and extent of contamination in the Columbia River water column and sediment are discussed in Section 3.1.4 of the 100-HR-3 Operable Unit Work Plan (DOE-RL 1992a). These areas of concern, as well as specific runoff events that may have caused potential sources of contamination, will be investigated during the LFI for the 100-HR-3 Operable Unit.

3.1.5 Air

Current releases of contamination into the air from 100-DR-2 could only be from fugitive dust from contaminated areas of the operable unit. Air quality investigations and contamination are discussed in greater detail in Section 3.1.5 of the 100-DR-1 Operable Unit work plan (DOE-RL 1992b).

3.1.6 Biota

Information pertaining to contamination of terrestrial biota exclusive of the riparian zone is presented in Section 3.1.6 of the 100-DR-1 Operable Unit Work Plan (DOE-RL 1992b). Information regarding contamination of aquatic biota in the Columbia River and the riparian zone from releases of hazardous substances from the 100-DR-2 Operable Unit is presented and evaluated in Section 3.1.6 of the 100-HR-3 Operable Unit Work Plan (DOE-RL 1992a).

3.2 POTENTIAL CORRECTIVE ACTION REQUIREMENTS (CAR)

Corrective action at the 100-DR-2 Operable Unit is required to comply with federal and state environmental laws and promulgated standards, requirements, criteria, and limitations that are legally applicable or relevant and appropriate under the circumstances presented by the release or threatened release of hazardous substances, pollutants, or contaminants. As stated in Chapter 1.0, cleanup of the 100-DR-2 Operable Unit will be addressed under the RCRA corrective action authority. Cleanup requirements for RCRA corrective actions (40 Code of Federal Regulations [CFR] 264.100) are not as fully documented as are those for remedial actions under CERCLA. The EPA has, however, identified groundwater protection standards for RCRA corrective actions, and has stated that other "relevant and applicable standards for the protection of human health and the environment" are to be identified in the RFI/CMS process.

Because the investigations described in this work plan are intended to aid in the definition of contaminant characteristics in the 100-DR-2 Operable Unit, the initial CAR cover a wide scope. Corrective action requirements are presented in Section 3.2 of the 100-DR-1 Operable Unit Work Plan (DOE-RL 1992b). The contaminant-specific requirements addressing currently known or suspected contaminants that may be present in the 100-DR-2 Operable Unit are the same as those listed in Section 3.2.1.1 and 3.2.1.2 of the 100-DR-1 Work Plan (DOE-RL 1992b).

3.3 POTENTIAL IMPACTS TO PUBLIC HEALTH AND THE ENVIRONMENT

This section presents a conceptual model of exposure pathways. Information on waste sources, pathways, and receptors is used to develop a conceptual understanding of exposure pathways for evaluation of potential risks to human health and the environment.

This preliminary assessment is based on current land and water use, which is commercial/industrial use, in the 100-DR-2 Operable Unit. This is appropriate because DOE is currently maintaining active institutional controls of the Hanford Site and intends on doing so for the foreseeable future. However, the possibility and consequences of future residential, agricultural, commercial/industrial, or recreational land uses may need to be considered for determining potential risk to receptors under these scenarios. Several other land use options identified for the 100 Area (as presented in the Final Report of the Hanford Future Site Uses Working Group) are as follows: (1) Native American uses; (2) limited recreation, recreation-related commercial uses and wildlife; (3) B Reactor as a museum/visitor center; and (4) wildlife and recreation. The methodology for conducting both a qualitative and baseline risk assessment for future potential land use scenarios has been developed, *Hanford Site Baseline Risk Assessment Methodology* (DOE-RL 1993b).

3.3.1 Conceptual Exposure Pathway Model

Based on information presented thus far, a preliminary conceptual model of potentially significant contaminant exposure pathways for the 100-DR-2 Operable Unit was developed. This model, which focuses on the current understanding of the operable unit, is presented in Figure 3-2. The model also includes media (i.e., groundwater, surface water and sediments, and aquatic biota) that will be specifically investigated under the 100-HR-3 Operable Unit Work Plan (DOE-RL 1992a).

The purpose of the conceptual model is to present hypotheses of operable unit-specific contaminant exposure pathways. During the RFI, the conceptual model hypotheses will be tested and refined in an iterative manner until the understanding of the operable unit is sufficient to support subsequent decisions regarding remedial action. By conducting the RFI in an iterative manner, the project becomes more efficient because the investigation remains in focus with operable unit-specific objectives.

Risk assessments and sensitivity analyses are two methods of testing and refining the conceptual model. Computer codes used in the risk assessment will be determined based on the site-specific modeling requirements identified during the RFI. Computer codes for risk assessment are identified in the Appendix of the Hanford Site Baseline Risk Assessment Methodology (HSBRAM) (DOE-RL 1993b).

Each exposure pathway must contain the following for there to be potential impact on human health or the environment:

- a contaminant source
- a contaminant release mechanism
- an environmental transport medium
- an exposure route
- a receptor.

3.3.1.1 Sources. Primary contaminant sources at 100-DR-2 include decommissioned and active facilities, trenches, cribs, french drains, septic tanks, burial grounds, and unplanned releases.

Soils at the 100-DR-2 Operable Unit may serve as a secondary contaminant source. Once a release to the environment occurs, contaminants can be bound in soils before being slowly re-released or they can be directly encountered by intrusion. Soil is indicated in Figure 3-2 as a secondary contaminant source.

Preliminary information on each of the operable unit waste facilities and their associated contaminants is presented in Section 2.1.3. Waste inventories have been estimated for some sources, where data are available. Groundwater, surface water, and river sediments are addressed through the 100-HR-3 Operable Unit work plan (DOE-RL 1992a).

3.3.1.2 Release Mechanisms. Release mechanisms can also be divided into primary and secondary categories. A primary release is one from a primary contaminant source, such as a release from a septic tank's drainage field to the soil; a secondary release is one that occurs for example, from the contaminated soil to the groundwater.

Process effluent at the 100-DR-2 Operable Unit are known to have infiltrated, intentionally and unintentionally, into the soils surrounding the various process effluent transfer, treatment, and disposal facilities. As indicated in Figure 3-2, the most significant of these release mechanisms at the 100-DR-2 Operable Unit is infiltration, and the most substantial contributions are from process effluent and fuel fabrication wastes. Although the reactor is no longer generating process effluent, past discharge of water contaminated with immobile substances could be a significant source of present contamination.

The most significant release mechanism from the secondary soil sources is desorption of the contaminants from the soil matrix, and infiltration to groundwater. Other potential mechanisms that could be significant are fugitive dust generation from dry, contaminated surface soils, and dispersion of such soils by wind or overland flow during precipitation events.

3.3.1.3 Environmental Transport Media. Contaminants in the soil can be transported to the surface by burrowing animals or possibly plant root uptake. Contamination could then migrate through wind transport dispersion. Biota may be a transport medium through ingestion, absorption or carrying contaminants lodged in fur. Contaminants can infiltrate the soil column and eventually reach the groundwater, which in turn, transports the contaminants to the Columbia River. The Columbia River also serves as a transport medium for these contaminants, as well as those introduced directly into the river.

3.3.1.4 Exposure Routes. Receptors can be exposed to contaminants through the following routes:

- inhalation of contaminants in the ambient atmosphere
- absorption of soil contaminants (for plants) or ingestion of contaminated materials and biota (for animals and humans)
- direct contact with contaminated media, including external radiation exposure from radionuclides.

3.3.1.5 Receptors. Receptors are organisms that have the potential for exposure to the released contaminants. Figure 3-2 divides this component of the pathway into humans and biota.

Because of the absence of nearby residences, the most likely potential for current human exposure to the 100-DR-2 Operable Unit contaminants is to onsite workers. Because most of the contamination is buried beneath the ground surface, the workers who could have the greatest potential exposure are those who will be involved in collecting environmental samples for this project.

The most likely point of contact for terrestrial animals (especially burrowing animals) is exposure by direct contact, inhalation, and ingestion of contaminated soil, water, plants, and animals. Terrestrial plants may be exposed in the root zone, where they could absorb buried contaminants or reach contaminated groundwater in the riparian zone. The likely exposure points in the aquatic environment are covered in Section 3.3.1 of the 100-HR-3 Operable Unit work plan (DOE-RL 1992a).

3.3.1.6 Summary. Preliminary evaluation suggests that the most probable primary sources of contaminant releases to the 100-DR-2 Operable Unit environment are the process effluent disposal facilities. Although some process effluent from the 100 D/DR Area were discharged directly to the Columbia River, the highly contaminated effluent discharged to the 116-DR-3 Storage Basin Trench, 116-DR-7 Inkwell Crib, and the Sodium Dichromate/Acid Pumping Station were disposed directly into the soil column. The current mechanism of contaminant release is through infiltration into the underlying groundwater from contaminated soils near the 100-DR-2 Operable Unit facilities. This groundwater eventually discharges into the river, where it can contaminate the sediments and has the potential to impose adverse impacts upon local biota, with possible food-chain effects on humans offsite. The conceptual exposure pathway model will be tested and refined during the RFI as additional data provide a better understanding of the operable unit.

3.3.2 Preliminary Identification of Contaminants of Concern

With the variety of waste types known to have been used and disposed of in the 100-DR-2 Operable Unit, it becomes necessary to focus on those that pose a potential threat to human health or the environment. The focus will be on those contaminants that are characterized by the following:

- present in the greatest quantity
- most hazardous
- most persistent in the environment
- found at elevated levels in the environment.

The information provided will be used for preliminary identification of operable unit contaminants of concern.

3.3.2.1 Quantity. One means to focus on those contaminants of greatest concern is to identify those contaminants that are potentially present in the greatest quantity. It should be noted that most of the quantities of waste disposed of are unknown and that waste inventories are not available for many of the compounds that may have been disposed within the

100-DR-2 Operable Unit. No disposal data are presently available for any organic compounds that may have been used at this site.

3.3.2.2 Hazard. The hazard of a contaminant is generally associated with toxicity. The definition of hazardous is basically waste that may cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness; or pose a substantial present or potential hazard to human health or the environment.

The primary constituents that would be present following the dissociation of acids or soluble salts include sodium, sulfate, fluoride, and chloride ions and chromium (VI). Sodium and chloride ions are considered essentially nontoxic to humans under most environmental conditions, but may influence the salinity of groundwater or surface water. Sulfate toxicity is minimal and ingestion is commonly associated with mild gastrointestinal effects. Fluoride may have beneficial effects at low levels but higher levels are associated with toxic human effects.

Chromium (VI) exhibits significant environmental or human toxicity that will be considered in the baseline risk assessment. Chromium (VI) is classified as an EPA Class A human carcinogen by the inhalation route; however, there is no evidence that chromium (VI) is carcinogenic from oral exposure (EPA 1991a). Systemic toxic effects include respiratory irritation and allergic reactions, *Quality Criteria for Water 1986* (EPA 1986). Chromium (III) can also exhibit toxic effects although not as severe as chromium (VI). Chromium (VI) is toxic to aquatic organisms. Ambient water quality criteria for the protection of freshwater organisms are: acute, 16.0 μg/L, and chronic, 11.0 μg/L (EPA 1986).

Cadmium may also exhibit significant environment or human toxicity. Cadmium accumulates in the kidney tissue and contributes to progressive renal damage that may result in renal failure. Occupational inhalation exposures to cadmium have been associated with lung damage and possibly lung and prostate cancer. Cadmium is classified as EPA Class B1 carcinogen by the inhalation route (EPA 1991a). Ambient water quality criteria are dependent on water hardness (EPA 1986).

Lead is a cumulative toxin producing symptoms that range from mild blood enzyme changes to severe neurological disease. Effects from lead exposures may be so subtle as to be without a threshold, and the EPA currently does not recommend quantitative evaluation of health effects associated with the lead exposures (EPA 1991a). Lead is classified as an EPA Class B2 carcinogen (EPA 1991a). Ingestion is a primary route of exposure. Ambient water quality criteria for lead are dependent on water hardness (EPA 1986).

Toxicity associated with mercury is highly dependent on the chemical form (inorganic, organic, elemental) and the route of exposure. Toxic effects include central nervous system damage with chronic exposure to inorganic mercury; exposure to organic mercury compounds can produce kidney disease, central nervous system effects, and birth defects. Inorganic forms of mercury can be methylated in sediments, in fish, and in the food chain for fish. Ambient water quality criteria for the protection of freshwater organisms are: acute, 2.4 μg/L, and chronic, 0.12 μg/L.

Polychlorinated biphenyls are of environmental and human concern because they are persistent and bioaccumulate. The primary toxicity associated with human occupational exposures to PCB is chloracne. Animal studies suggest PCB may cause liver damage, liver cancer, and reproductive effects; however, these effects have not been confirmed in humans. Polychlorinated biphenyls are classified as an EPA Class B2 carcinogen (EPA 1991a). A 24 hour average freshwater quality criterion for PCB of 0.014 μg/L is considered protective for both acute and chronic toxicity (EPA 1986).

Asbestos, known to be present in operable unit buildings, is a known human carcinogen. Exposures to asbestos are associated with chronic lung disease (asbestosis), lung cancer, and mesothelioma (a rare and rapid fatal cancer). Asbestos is classified as an EPA Class A human carcinogen (EPA 1991a).

Nitrate is a decomposition product of nitric acid. This inorganic ion is of concern primarily because of possible human health effects. High levels in drinking water can produce problems in the oxygen transport system of the blood. Infants are particularly sensitive to this toxic effect.

The potential exposure to any of the radionuclides is toxicologically significant. The dose response functions used by EPA to estimate radiation risks (linear and linear quadratic) presume that any radionuclide exposure carries with it some associated excess cancer risk. Consequently, based on conservative assumptions, the presence of and potential exposure to any radionuclide at greater than background concentrations is presumed to introduce some excess cancer risk that must be evaluated. In light of the additive effects of the various radionuclides, all of the isotopes of concern identified during RFI activities must be considered in the baseline assessment of cancer risk.

The toxic effects of a contaminant in the environment on biological systems vary dramatically between species. Toxic substances may display effects on survival, reproduction, behavior, and physiology.

Metals such as cadmium, chromium, lead, and mercury are of concern because they may bioaccumulate. Rates of bioaccumulation vary depending on the chemical form of the metal, the metal's relationship with the local physical environment (eg., soil pH), and the species position in the food chain, as reported in *Wildlife Toxicology* (Peterle 1991). Mercury is also a neurotoxin to all organisms. Ionizing radiation can be damaging to all organisms, however, the effects depend on the level of radiation and each organism's sensitivity.

3.3.2.3 Persistence. The compounds present include corrosives, radionuclides, metals, and other persistent compounds. Corrosive acids, bases, and salts such as nitric acid, sodium hydroxide, and sodium fluoride, do not persist in the environment in their original form because they rapidly dissociate into their constituent ions once they come in contact with water. The constituent ions may pose less of an immediate environmental and toxicological concern than the parent compound; however, the ions may persist and accumulate with time in the environment, producing concern over long-term effects. For example, gradual increases in nitrate in surface waters and groundwater are linked to human health effects and environmental effects such as eutrophication of lakes. Metals such as chromium are also persistent in the environment and may pose an environmental and toxicological concern.

The environmental persistence of a radionuclide is in part directly related to the half-life of the particular isotope.

3.3.2.4 Environmental Occurrence. The environmental occurrence of contaminants at the 100-DR-2 Operable Unit can be determined empirically through the evaluation of existing 100 D/DR groundwater data. Groundwater in and adjacent to the 100 Areas is contaminated with tritium, nitrate, strontium-90, and chromium (VI). Chromium (VI) contamination resulted from widespread use of sodium dichromate and chromic acid. One potential source of nitrate is nitric acid. Although other contaminants have been identified in the groundwater within the 100 D/DR Area, it is not currently possible to assign any of these contaminants to specific 100-DR-2 Operable Unit sources. The radiological sampling efforts undertaken in conjunction with decommissioning activities have identified the radionuclides known to be present at the 100-DR-2 Operable Unit. Radionuclides have also been detected in the groundwater.

3.3.2.5 Summary of Preliminary Contaminants of Concern. The following is a list of preliminary contaminants of concern for the 100-DR-2 Operable Unit:

<u>Metals</u>	<u>Radionuclides</u>
cadmium	tritium
chromium	carbon-14
lead	cobalt-60
mercury	nickel-63
	strontium-90
<u>Nonmetallic Ions</u>	technetium-99
nitrate	ruthenium-106
nitrite	iodine-129
sulfate	cesium-137
	europium-152, -154, -155
<u>Other</u>	uranium-235, -238
asbestos	plutonium-238, -239, -241
PCB	americium-241

This list was developed based on the types of wastes known to have been disposed of, or to have been derived from a constituent known to have been disposed of at the 100-DR-2 Operable Unit, and the contaminant characteristics presented in Section 3.3.2. The list contains metals, nonmetallic ions, and radionuclides; it does not include organic compounds with the exception of PCB. Organic compounds have not been included because data are currently unavailable on the types, locations, and quantities of organic compounds that may have been disposed of at the 100-DR-2 Operable Unit. Additional contaminants of concern may be identified when the nature of contamination is identified during the limited field sampling performed during the LFI.

3.3.3 Assessment of Need for Expedited Response Actions

Expedited response actions are either removal actions under the DOE authority of the Atomic Energy Act, removal actions under CERCLA (40 CFR 300.415), or interim measures under RCRA proposed (40 CFR 264.540). In deciding whether an ERA is appropriate, both technical engineering judgement and an evaluation of potential threat to human health and the environment are considered. The decision to conduct an ERA is based on the immediacy and magnitude of the potential threat to human health and the environment, the nature of appropriate corrective action, and the implications of deferring the corrective actions. Basically, ERA are conducted when an unacceptable health or environmental risk and a short-time frame available to mitigate the problem exist.

During the work plan scoping, DOE, Ecology, and EPA determined that ERA are not currently warranted in the 100-DR-2 Operable Unit. This determination was based in part on the conceptual exposure pathway model presented herein. The discussion in this section briefly reviews the assessment of the need for ERA, which was based on the current understanding of site conditions. The conclusions in this section are tentative, and will be subject to refinement as data are collected throughout the RFI process.

3.3.2.1 Human Health. Based on the existing environmental data discussed in Section 3.1, and the exposure pathways discussed in Section 3.3.1, the 100-DR-2 Operable Unit does not appear at this time to pose an immediate danger to human health. The conceptual exposure pathway model indicates that on-site workers are currently the most significant potential human receptor population. Essentially all of the contamination is below the ground surface, and on-site controls are sufficient to prevent contact with contaminants. Surface radiation surveys are performed annually to identify those sites with surface contamination. All areas of known surface contamination are posted. Once the RFI is completed, potential corrective action measures are reviewed and evaluated. The results of the RFI may be used as the basis to take some actions, either an ERA, an IRM, or the LFI pathway. The interim measure or in this case, the interim remedial measure may be necessary to stabilize a release and mitigate harm to human health. Intrusive field activities will be performed within the boundaries of the 100-DR-2 Operable Unit. The general considerations, requirements, procedures, and plans set forth in the Health and Safety Plan developed for remedial investigation activities at the 100-DR-2 Operable Unit (Appendix B of this work plan) will adequately cover the surface investigations proposed for the 100-DR-2 Operable Unit. The plan specifies site control and personnel monitoring procedures that will ensure the health and safety of those involved with the field portions of the project.

3.3.2.2 The Environment. Existing information and ongoing Hanford Site monitoring, as well as site access restrictions, and the exposure pathways discussed in Section 3.3.1, indicate that imminent and substantial endangerment to the environment does not exist within the 100-DR-2 Operable Unit. Essentially all of the contamination is below the ground surface.

3.4 PRELIMINARY CORRECTIVE ACTION OBJECTIVES AND CORRECTIVE ACTION ALTERNATIVES

This section develops both interim and final preliminary corrective action objectives, general response actions, remedial technologies and process options, and a range of preliminary corrective action alternatives for each group of prioritized facilities within the 100-DR-2 Operable Unit. This evaluation is based on available site data, the QRA and the conceptual exposure pathway model that were presented earlier in this work plan. General response actions are identified and represent broad classes of corrective actions that may be appropriate to achieve corrective action objectives. Corrective action objectives may change or be refined as additional site data are gathered and evaluated during the LFI and implementation of the IRM. Recommendations are made as to the range of preliminary corrective action alternatives that will be considered and more fully developed in the FS outlined in Section 5.2 of the 100-DR-1 Work Plan (DOE-RL 1992b). In addition, the observational approach is described and incorporated throughout this section with a bias toward action through implementation of IRM. This approach and the *Hanford Past-Practice Strategy* (DOE-RL 1991a) are used to limit the range of corrective action alternatives that will be evaluated in the focused feasibility study, if necessary.

Overall, the Hanford past-practice RFI/CMS process is defined as the combination of IRM (including concurrent characterization), LFI for final remedy selection where interim actions are not clearly justified, and feasibility/treatability studies for further evaluation of treatment alternatives. After completion of an IRM, data including concurrent characterization and monitoring data will be evaluated to determine if a final remedy can be selected for the operable unit.

Interim corrective measures may be implemented before the land issues are resolved. The corrective action alternatives will not be limited during evaluation and implementation of IRM because of land use. If land use is later determined to require more stringent cleanup standards than required during implementation of the IRM, a final corrective action alternative based on land use will be selected.

Figure 3-3 identifies the interim corrective action objectives, the general interim response actions, the interim remedial technologies, and the process options which are discussed in the following sections. It also presents the potential conflict with CAR or future land/water use associated with each of the process options. The criteria used to determine whether conflict exists includes the extent of site contamination, type of contaminants, land use options, governing regulatory authority (state or federal), and the implications of each process option. As land use is decided, the potential for conflict may change.

3.4.1 Preliminary Corrective Action Objectives

The fundamental objective of the RFI/CMS at the 100-DR-2 Operable Unit is to protect environmental resources and/or human receptors from the threats that may exist resulting from the known or suspected contamination. Specific corrective action objectives will depend, in part, on current and potential future land use for the 100 Area and the Columbia River.

Specific interim and final corrective action objectives must consider both current land and water uses, and reasonable potential future land and water use in the 100 Area and the Columbia River. Potential future land and water use will affect the risk-based cleanup objectives, potential CAR and point of compliance. The corrective action objectives for protecting human health for residential or agricultural land use would be based on risk assessment exposure scenarios requiring cleanup to lower levels than for recreational or industrial land use. It is important that potential future land use and the corrective action objectives be clearly defined and agreed upon by the three parties, prior to further and more detailed evaluation of corrective actions. Data collection requirements and corrective actions required to meet the objectives based on a specific land use may not be consistent with objectives for other land use.

To focus the RFI/CMS with a bias for action through implementing IRM, the following preliminary corrective action objectives are identified for the 100-DR-2 Operable Unit. These objectives are identified for both current and reasonable potential land uses:

- Reduce the risk of harmful effects to the environment and human recreational users of the area by reducing the toxicity, mobility, or volume of contaminants from the source areas to meet CAR or risk-based levels that will allow the use of the area for wildlife habitat and/or recreational use. (This is a potential final corrective action objective, and is also an interim remedial action objective based on current wildlife and recreational use on the Columbia River).

- Reduce the risk of harmful effects to human receptors by reducing the toxicity, mobility, or volume of contaminants from the source areas to meet CAR or risk-based levels that will allow residential use of the 100 Area. (This is a potential final corrective action objective, but interim actions could be implemented consistent with this objective.)

- Reduce the risk of harmful effects to livestock, food chain crops and human receptors by reducing the toxicity, mobility, or volume of contaminants from the source areas to meet CAR or risk-based levels that will allow agricultural use of the 100 Area. (This is a potential final corrective action objective, but interim actions could be implemented consistent with this objective.)

- Reduce the risk of harmful effects to onsite workers by reducing the toxicity, mobility, or volume of contaminants from the source areas to meet CAR or risk-based levels that allow industrial use of the 100 Area. (This is a potential final corrective action objective and an interim corrective action based on current land use.)

3.4.2 Preliminary General Response Actions

General response actions which represent broad classes of corrective actions that may be appropriate to achieve both interim and final corrective action objectives at the 100-DR-2 Operable Unit are presented in Figure 3-3. The following are the general response actions, followed by a brief description for the 100-DR-2 Operable Unit:

- no action (applicable to specific facilities)
- institutional controls
- waste removal and treatment or disposal
- waste containment
- combinations of the above actions.

No action is included for evaluation as required by the NCP (40 CFR 300.68 (f)(1)(v)). No action also provides a baseline for comparison with other response actions. Finally, no action may be appropriate for some facilities and sources of contamination if the risk assessment determines that unacceptable natural resource or human health risks are not presented by those sources or facilities and that contaminant-specific CAR are not exceeded.

Institutional controls involve the use of physical barriers or access restrictions to reduce or eliminate public exposure to contamination. Considering the nature of 100-DR-2 Operable Unit and the Hanford Site as a whole, institutional controls will likely be an integral component of all interim corrective action alternatives. Many access and land use restrictions are currently in place at the site and will remain during implementation of IRM. Institutional controls may also be important for final corrective alternatives. The decisions regarding future land use at the 100 Area will be important in determining whether institutional controls will be a part of the corrective alternative, and what type of controls may be required.

Waste removal and treatment or disposal involves excavation of contamination sources for eventual treatment and/or disposal either on a small- or large-scale basis. One approach being considered for large-scale waste removal is Large-Scale Remediation (LSR), which is based on high-volume excavation using conventional mining technologies. Waste removal on a macroengineering scale would be used over large areas such as groups of waste sites, operable units, or operational areas. Waste removal on a small scale would be conducted for individual waste units on a selective basis. Waste removal could be conducted as either an interim or final corrective action.

Waste containment includes the use of capping technologies (i.e., capping and grouting) to minimize the driving force for downward or lateral migration of contaminants. Capping also provides a radiation exposure barrier and a barrier to direct exposure. In addition, these barriers provide long-term stability with relatively low maintenance requirements. Containment actions may be appropriate for either interim or final remedial actions.

Waste treatment involves the use of biological, thermal, physical, or chemical technologies. Typical treatment options include biological landfarming, thermal processing, soils washing/dechlorination, and stabilization/fixation. Some treatment technologies may be pilot tested at the highest priority facilities. Waste treatment could be conducted either as an interim or final action and may be appropriate in meeting corrective action objectives for all potential future land uses.

Combinations of the above actions may be used in several different alternatives. For example, containment actions could be used in combination with removal actions for highly contaminated areas, and institutional controls (i.e., fences and deed restrictions) to prevent disruption of the containment system.

Implementation of the general response actions will be accomplished using an observational approach. Such an approach is iterative, where each iteration results in a more refined conceptual model. Data needs are determined by the model, and data collected as a result of an action to fulfill these needs are used as additional input to the model. Use of the observational approach while conducting response actions of the 100 Area will result in the opportunity for integrating these actions with longer range objectives of final site remediation including other analogous areas. Site characterization and remediation data will be collected concurrently with the use of LFI, IRM, and pilot-scale remediation testing to apply knowledge gained to similar areas. The overall goal of this approach is convergence on a response action as early as possible while continuing to obtain valuable characterization information during remediation phases.

3.4.3 Preliminary Remedial Action Technologies and Process Options

The preliminary contaminant-specific CAR, the QRA, and the current and potential future land and water use of the 100 Area will serve as the basis for establishing target cleanup levels for remediation of each operable unit facility area. Preliminary corrective action technologies and process options associated with each general response action and corrective action objective are identified and compared with potential CAR and future land and water use in Figure 3-3. These technologies and process options may be applicable to the 100-DR-2 Operable Unit based on current available data, present knowledge of the site and individual facility units, and their associated primary contaminants of concern. Available treatment technologies are limited for radiological and hazardous waste contaminated sites.

3.4.4 Preliminary Corrective Action Alternatives

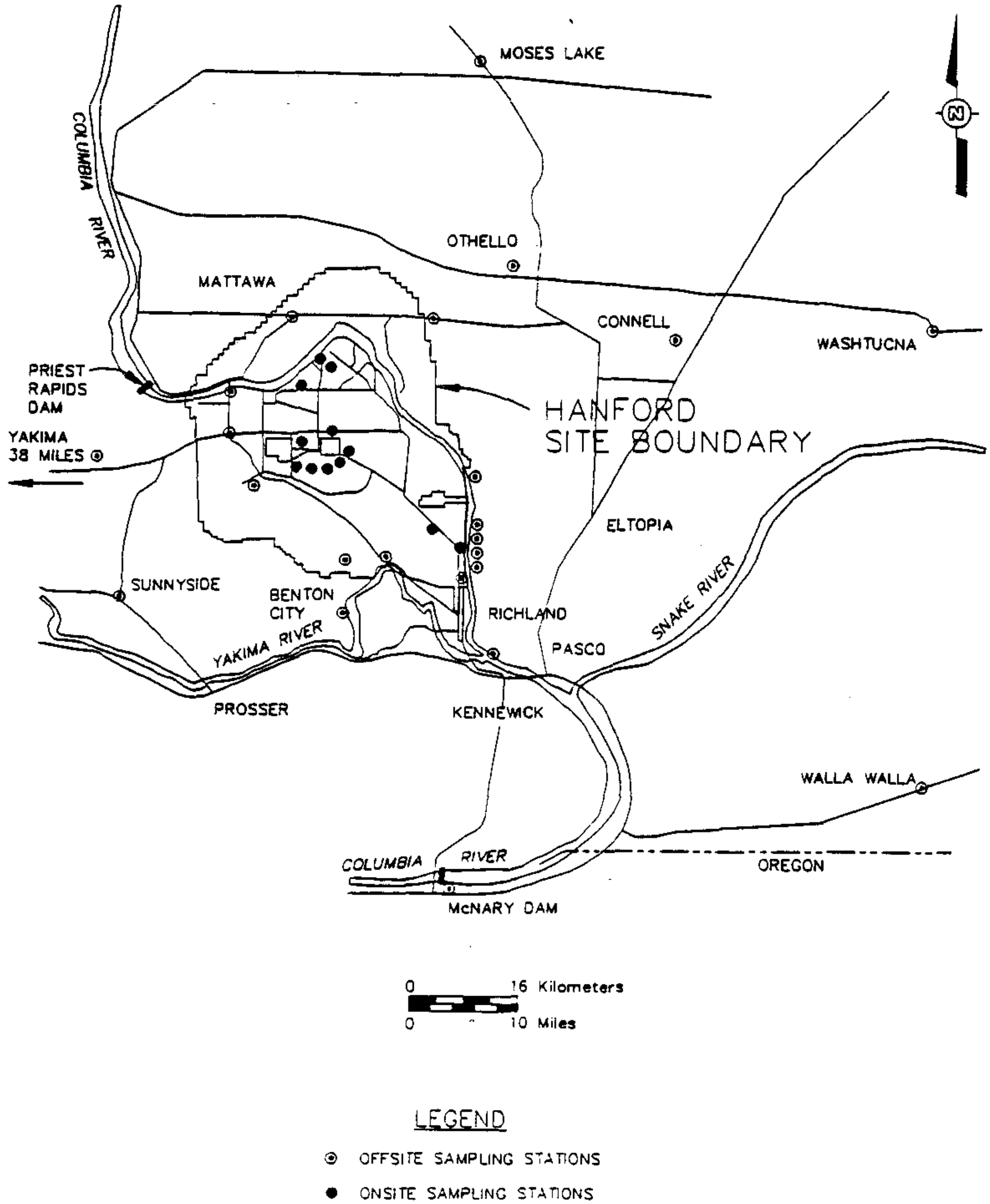
A range of preliminary interim and final corrective action alternatives will be evaluated for implementation at the 100-DR-2 Operable Unit. During the work plan rescoping efforts, the three parties have established priority waste sites where it is anticipated that an IRM will be implemented. Final selection of sites for interim action will be based on the results of LFI and the conceptual exposure pathway model and QRA. Corrective action alternatives for lower priority sites will be evaluated as part of the final remedy selection process for the operable unit record of decision (ROD).

Interim and final corrective action alternatives for waste sources in the 100-DR-2 Operable Unit would be similar for some alternatives. However, the final corrective action alternatives must meet corrective action objectives based on future land uses in the 100 Area to select a final remedy. Some interim and final corrective action alternatives may only meet specific objectives for certain land uses and may be inconsistent with other land uses. A range of alternatives will be developed for evaluation in the focused FS, and will likely include:

- alternatives emphasizing containment
- alternatives emphasizing removal, treatment and disposal
- alternatives emphasizing institutional controls
- alternative of no action.

The corrective action alternatives will be addressed and evaluated in the 100 Area FS, the focused FS, and the final FS, discussed in Section 5.2 of the 100-DR-1 Work Plan (DOE-RL 1992b). These studies may address additional alternatives or eliminate certain alternatives described above.

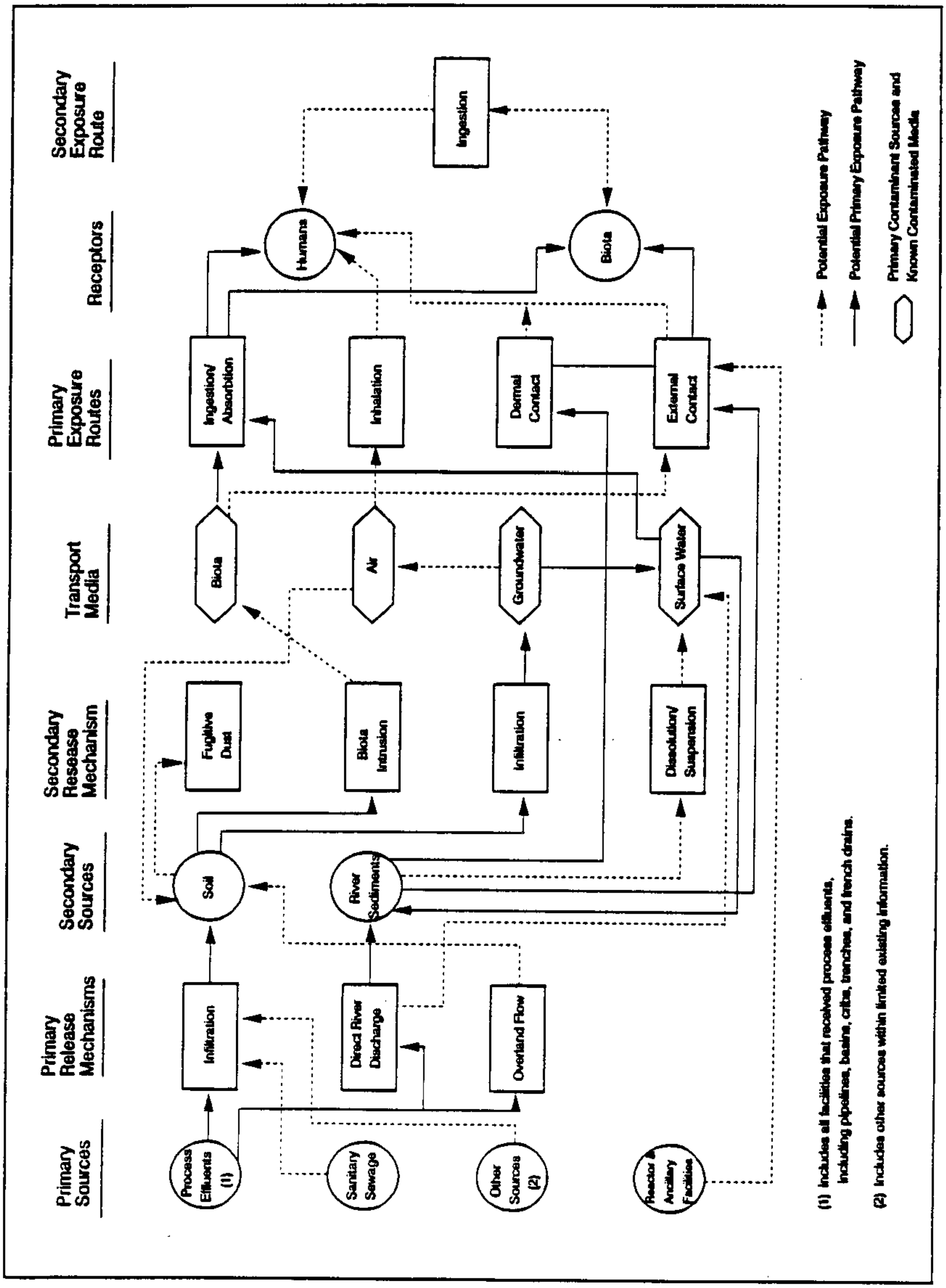
Figure 3-1 Background Sampling Stations for Soil and Vegetation



Source: Jaquish and Bryce 1990.

THIS PAGE INTENTIONALLY
LEFT BLANK

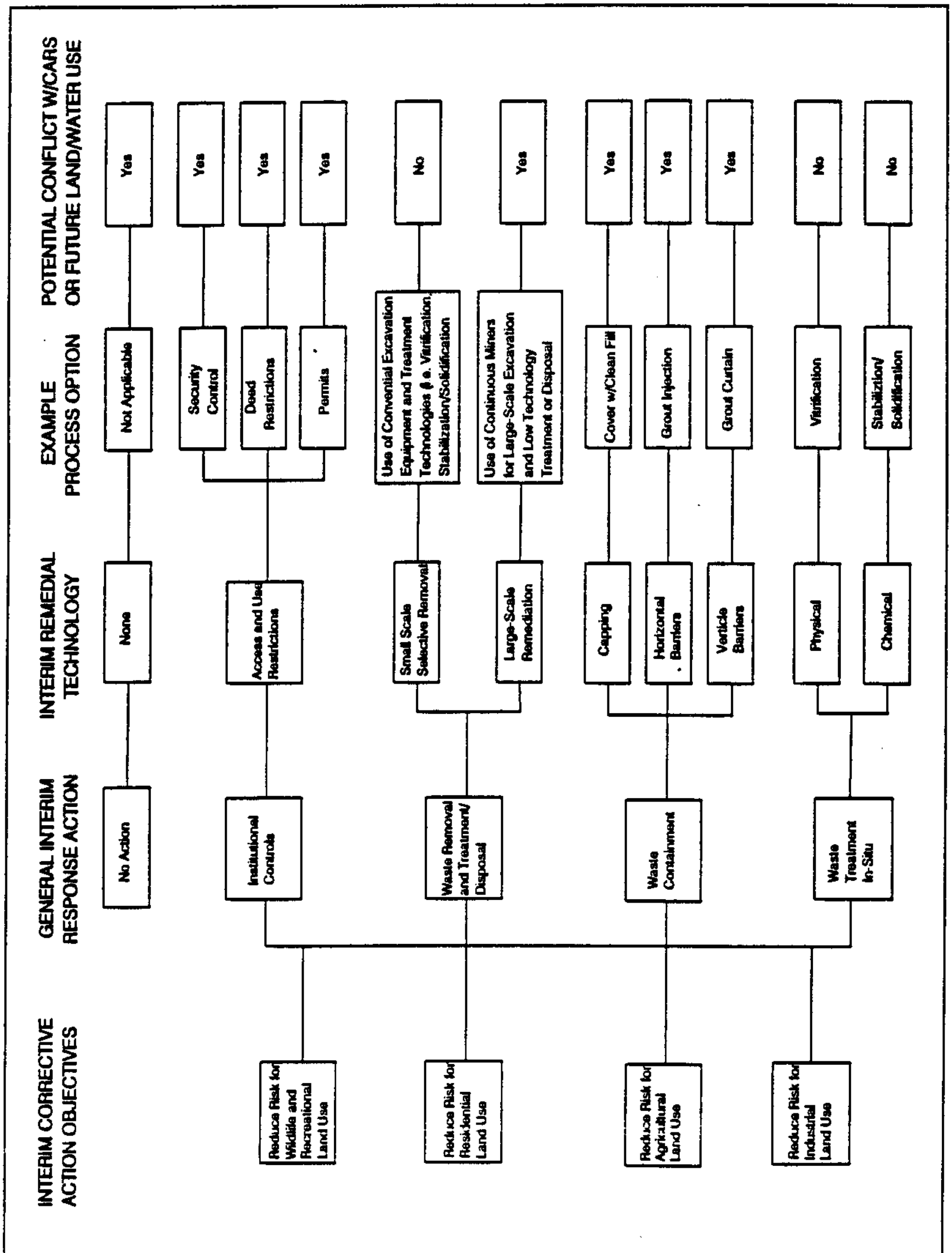
Figure 3-2 Contaminant Exposure Pathway for the 100-DR-2 Operable Unit



9413296.1688

THIS PAGE INTENTIONALLY
LEFT BLANK

Figure 3-3 A Matrix of Preliminary Interim Response Actions, Technologies, and Process Options Available



THIS PAGE INTENTIONALLY
LEFT BLANK

Table 3-1 1989 Data From Onsite and Offsite Soil Sampling Hanford Environmental Monitoring Program

	Onsite[a] Average pCi/g (dry weight[b])	Offsite[a] Average pCi/g (dry weight[b])
Strontium-90	0.25 ± .33	0.13 ± .03
Cesium-137	2.48 ± 9.90	0.74 ± .27
Plutonium-239/240	0.061 ± .296	0.013 ± .003
Uranium	0.60 ± .51	0.73 ± .13

[a] = Onsite and Offsite are as shown on Figure 3-1; numbers of onsite samples = 12; number of offsite samples = 23.

[b] = The values given after ± sign are two standard errors of calculated mean.

Source: Adapted from Jaquish and Bryce 1990.

THIS PAGE INTENTIONALLY
LEFT BLANK

Table 3-2 Hanford Site Background Summary Statistics and Upper Threshold Limits for Inorganic Analytes

Analyte	95% Dist[a] (mk/kg)	95% UTL[b] (mg/kg)	Analyte	95% Dist[a] (mg/kg)	95% UTL[b] (mg/kg)
Aluminum	13,800	15,600	Silver	1.4	2.7
Antimony	NR*	15.7[c]	Sodium	963	1,290
Arsenic	7.59	8.92	Thallium	NR*	3.7[c]
Barium	153	171	Vanadium	98.2	111
Beryllium	1.62	1.77	Zinc	73.3	79
Cadmium	NR*	0.66[c]	Molybdenum	NR*	1.4[c]
Calcium	20,410	23,920	Titanium	3,020	3,570
Chromium	23.4	27.9	Zirconium	47.3	57.3
Cobalt	17.9	19.6	Lithium	35	37.1
Copper	25.3	28.2	Ammonia	15.3	28.2
Iron	36,000	39,160	Alkalinity	13,400	23,300
Lead	12.46	14.75	Silicon	108	192
Magnesium	7,970	8,760	Fluoride	6.4	12
Manganese	562	612	Chloride	303	763
Mercury	0.614	1.25	Nitrite	NR*	21[c]
Nickel	22.4	25.3	Nitrate	96.4	199
Potassium	2,660	3,120	Ortho-phosphate	3.7	16
Selenium	NR*	5[c]	Sulfate	580	1,320

NOTES:
* = Not reported
[a] = 95th percentile of the data for a lognormal distribution.
[b] = 95% confidence limit of the 95th percentile of the data distribution.
[c] = Limit of detection.
adapted from DOE-RL (1993c)

THIS PAGE INTENTIONALLY
LEFT BLANK

4.0 RATIONALE AND APPROACH

The RFI/CMS is the method by which risks are characterized and corrective action alternatives are evaluated. There are specific data quality objectives (DQO) and data needs that must be identified prior to designing a data collection program. The data collected are used as a basis for making an informed risk management decision regarding the most appropriate corrective action. The data needs and DQO are based in part, on the Hanford Past-Practice Strategy (DOE-RL 1991a) described in Section 1.1. This strategy and the scoping effort of the EPA, DOE and Ecology emphasize a bias for action, by quickly and efficiently implementing ERA and IRM, to achieve cleanup at high priority areas of contamination. The three parties did not identify any candidate sites within this operable unit for conducting ERA (during the scoping effort). Several sites have been identified as potential candidates for conducting an IRM. Some sites require additional data or information to be collected through LFI. Either way, the sites are IRM candidates. All sites are subject to a QRA. The three parties also recognize the need to more closely integrate source and groundwater operable unit investigations and remediation, and acknowledge that some environmental media should be investigated on an aggregate area basis.

To implement this strategy, data are needed for specific waste sources, groundwater contaminant plumes and contamination of other environmental media to refine existing conceptual models and to conduct a QRA. Data are also needed to complete a quantitative baseline risk assessment and select a final remedy for the overall operable unit and the 100 Area NPL Site, respectively. Some of these data will be collected during the 100-DR-1 and 100-HR-3 LFI, and other data can be collected as needed when implementing the IRM or preparing the final CMS. Section 4.1 describes the DQO for all these data needs and indicates whether data will be obtained during source, groundwater, or aggregate area investigations. The approach for collecting, analyzing, and evaluating these data is presented in Section 4.2. The approach presented here is in general terms; the specific RFI/CMS tasks are described in Chapter 5.0.

4.1 DQO PROCESS

The central rationale for undertaking RFI at the 100-DR-2 Operable Unit is to develop needed data that are lacking in the available information. The amount and quality of available information are not adequate to quantify the risk posed by the operable unit and to complete the CMS.

The rationale for the technical approach presented in this RFI/CMS work plan is based on two concepts. First, every activity and effort of the RFI field program shall be justified by producing data for one or more of the following project purposes:

- Confirm or revise the conceptual models for specific waste sites/areas of contaminated environmental media for the operable unit and aggregate area.

- Support a QRA.

- Support development and evaluation of IRM for individual waste sites, groups of sites or areas of environmental contamination.

- Support the quantitative baseline risk assessment for the operable unit. The baseline risk assessment may be necessary in addition to the QRA to support the final RFI.

- Support the CAR evaluation.

- Support the development, evaluation, and selection of a final remedial alternative.

Second, a streamlined approach with a bias-for-action will be followed through the use of LFI. This approach will focus on obtaining data sufficient to implement IRM and will use the observational approach during implementation of the remedy to reduce the amount of data required to initiate cleanup. The emphasis in this work plan is on describing those data that will be obtained at high-priority areas of contamination to determine whether to implement IRM. However, general data needs for the quantitative risk assessment and final remedy selection are also addressed. Other secondary data uses include, health and safety planning, and environmental monitoring during the implementation of a remedial action.

The methods used to identify data uses and needs can be referenced to Section 4.1.1 of the 100-DR-1 Operable Unit work plan (DOE-RL 1992b) or *Data Quality Objectives for Remedial Response Activities* (CDM Federal Programs Corporation 1987). The three elements of the DQO process are: (1) the identification of data users, (2) identification of data uses and needs, and (3) data collection program design.

4.1.1 Data Users

The primary data users will be the decision makers identified in the Tri-Party Agreement. These are the DOE, the EPA, and Ecology. Additional primary data users will be any technical lead organization responsible for the RFI/CMS tasks as directed by DOE, EPA, and Ecology. Secondary data users include the support groups within the technical lead organization who may utilize the data for activities not necessarily associated with this investigation (i.e., Geosciences for site-wide modeling). Other potential data users include technical support groups who provide input through the review process described in environmental investigation instruction (EII) 1.9 of the *Environmental Investigations and Site Characterization Manual* (WHC 1988).

4.1.2 Identification of Data Uses and Needs

The second element of the DQO process is the identification of data uses and needs. The determination of data uses and needs is supported by evaluation of available data, and development of an operable unit conceptual model. These are presented in Chapters 2 and 3 of this work plan. The data that have been reviewed are the basis for prioritizing sites for conducting LFI, which may lead to IRM. Historical data were discussed at scoping meetings with the DOE, EPA, and Ecology to develop the final strategy for each site. The information has also been used to help determine what additional data must be obtained.

The data types needed to support the decision making process are outlined below:

- location, disposal history, and construction of all identified and newly discovered contaminant sources (100-DR-2 Operable Unit)

- quantity, nature, and extent of contamination in surface soils, the vadose zone and aquifer matrix, especially from disposal of radioactive and nonradioactive liquid wastes in the cribs and trenches

- geochemical, geologic, and physical characteristics of the vadose zone, especially in relation to the fate and transport of contaminants from waste sites in the groundwater (100 Area source operable units and 100 Area aggregate investigations)

- an understanding of the relationship between water-table fluctuations (especially related to fluctuations in levels in the Columbia River) and release and transport of contaminants from the lower vadose zone and capillary fringe to groundwater (100-HR-3 Groundwater Operable Unit and 100 Area aggregate investigations)

- the nature and geometry of the hydrologic system, including the thickness, areal extent, and intrinsic properties (e.g., hydraulic conductivity) of the various hydrostratigraphic units (100-HR-3 Groundwater Operable Unit and 100 Area aggregate investigations)

- horizontal and vertical gradients in contaminated hydrostratigraphic units (100-HR-3 Groundwater Operable Unit)

- information on the nature of contamination in water emanating from seeps and springs along the shoreline of the Columbia River in the 100 Area, and the nature and extent of contamination in seep and spring sediments and adjacent river water (Surface Water/Sediment Investigations for the 100 Area, Appendix D-1 of the 100-HR-3 Operable Unit work plan)

- information on the nature and extent of contamination in the terrestrial, riparian and aquatic biota adjacent to and in the vicinity of the 100 H Area (100 Area aggregate investigations)

- information on the potential for airborne contamination from fugitive dust (100-DR-1 Source Operable Unit)
- information on the groundwater recharge and discharge, and contaminant transport from offsite sources to the 100 H Area (100-HR-3 Groundwater Operable Unit and 100 Area aggregate investigation)
- the impact of fluctuations in river stage on shallow groundwater flow (100-HR-3 Groundwater Operable Unit).

Table 4-1 is a summary of the data needs for the 100-DR-2 Operable Unit. If additional data are needed at the completion of the LFI to evaluate IRM, additional data may be collected as part of the focused FS.

The quality of the data needed is defined by sampling and analysis protocols outlined in the QAPjP (Appendix A). Table QAPjP-2, Sampling and Investigative Procedures for the Limited Field Investigation in the 100-DR-2 Source Operable Unit, lists all of the EII that will be followed throughout the LFI. The quantity of data needed is difficult to define at the LFI stage. The goal is to obtain sufficient data to identify the nature and vertical extent of contamination. The final quantity of data obtained will be dependent on information from analogous facilities, and information collected by employing the observational approach in the investigations. The specific analytical requirements related to precision and accuracy parameters are detailed in Appendix A (Table QAPjP-1).

The DQO specific to the LFI program for 100-DR-2 are shown on Table 4-2. These data types were developed from the list of preliminary contaminants of concern. The minimum analytical detection limits shown on Table 4-3 were selected as one-tenth of the 10^{-6} risk based exposure level for ingestion of carcinogenic contaminants or by the concentration equivalent to an ingestion exposure at a hazard quotient (HQ) of 0.1 for non-carcinogenic contaminants. The minimum analytical detection limits for the radionuclides on Table 4-3 utilize the carcinogenic-based exposure. The minimum analytical detection limit shown on Table 4-3 for chromium utilizes the 0.1 of the HQ since chromium is not classified as a carcinogen via ingestion. The 10^{-6} risk-based exposure level and the 0.1 HQ equivalent concentration for chromium was calculated using the HSBRAM (DOE-RL 1993b).

In addition to the data types shown in Table 4-2, geologic descriptions, soil types, and contamination physical position(s) are necessary to support the data uses. This information is obtained through standard geologic description methods described in the QAPjP.

Precision and accuracy results from the laboratory will be compared with those identified for the particular analytical method employed. Sampling representativeness is controlled by the sampling program for the particular site. At the 100-DR-2 limited field sampling sites, samples will be selected for analysis through screening, with a bias for sending contaminated samples to the laboratory for analysis. The target for completeness for the analysis is set for 70% of the requested analytes for each sample submitted. Comparability will be judged by whether or not the precision and accuracy goals are met and how well the data collected from the limited field sampling compares with historical data from the same horizon.

4.1.3 Design of Data Collection Program

The final element of the DQO process consists of the design of a data collection program. The associated QAPjP provides the mechanism by which the data collection program is implemented, controlled, and documented.

4.2 INVESTIGATION STRATEGY

The overall approach to the 100-DR-2 Operable Unit investigation is based on the Hanford Past-Practice Strategy (DOE-RL 1991a) and is described in Chapter 1.0. In particular, this strategy recognized that to expedite the ultimate goal of cleanup, much more emphasis needs to be placed on initiating and completing waste site cleanup through interim measures.

4.2.1 Hanford Site Past-Practice Strategy

The three parties have agreed to a streamlined approach to past-practice sites at the 100 Area that is intended to maximize efficiency, maintain project schedules, and achieve earlier remedial action. Figure 4-1 is a decision flow chart that shows the streamlined Hanford Site RI/FS (RFI/CMS) process.

Following the agreement on the past-practice strategy, the three parties rescoped the initial 100 Area work plans with a bias toward interim remedial action, and with the initial focus of the limited intrusive investigations placed on the highest-priority waste sites within each operable unit. The collective knowledge and judgement of the three parties and the information contained in the existing work plan were used to identify the high-priority waste sites and the paths to be followed to implement the new, streamlined strategy. The decisions made during joint meetings with the three parties were documented by meeting minutes that are part of the administrative record.

The near-term strategy agreed to by DOE, EPA, and Ecology for the 100 Area source operable units focuses on two preferred decision making paths which will lead to interim remedial measures:

- Limited field investigations will be performed at high-priority waste sites where only limited data are needed to make decisions for conducting an IRM.
- Interim remedial measures have been determined appropriate along the IRM path, without additional field investigations at waste sites where existing data are considered sufficient to indicate that the site poses a risk through one or

more pathways, based on information in existing work plans, data collected from analogous facilities, and the collective knowledge of the three parties.

The 100-DR-2 Operable Unit Work Plan approach described below focuses on these preferred decision-making pathways.

4.2.2 Investigation Strategy for the 100-DR-2 Operable Unit

This work plan describes the approach for implementing the past-practice strategy for currently identified contaminant sources at the 100-DR-2 Operable Unit. Investigations at the low-priority sites will be deferred for long-term action for the final remedy selection process (see Table 4-2), as deemed necessary.

Table 4-3 lists the 100-DR-2 facilities to be addressed by the past-practice investigation strategy, the facilities to be deferred to decommissioning, and facilities to be deferred to the final remedy selection. The table also describes, in general terms, the number and location of boreholes where limited intrusive field investigations are to be performed to define the nature and vertical extent of contamination, and lists those facilities for which the three parties have determined sufficient data exists that an IRM is appropriate without further field investigations. At these sites, further characterization will be performed concurrently with remediation, using the observational approach. Figure 4-2 shows the IRM selection process.

Options for contingencies have also been developed as part of the past-practice strategy, which include:

- Perform treatability studies or technology demonstrations at selected facilities and use data from analogous 100-DR-2 Operable Units or 100 Area facilities; the decision as to which waste sites will ultimately be selected as candidates for these studies must be agreed upon by the three parties at future unit managers meetings.

- Collect additional data during a focused FS.

- Defer a waste site to the final remedy selection process.

Details on facilities within the 100-DR-2 Operable Unit and proposed investigations are listed in Table 4-3. Proposed investigations shown on Table 4-3 may require modifications as data are collected and evaluated from other 100 Area analogous sites. Changes of scope to the investigative strategy and LFI described in this work plan will be documented by minutes in the monthly unit managers meetings.

4.2.2.1 Investigations at High-Priority Liquid Waste Disposal Facilities. The IRM path, as shown in a logic diagram in Figure 4-3, is proposed at the following liquid waste disposal facilities in the 100-DR-2 Operable Unit:

- 116-DR-3 (105-DR) Storage Basin Trench
- 116-DR-6 (1608) Liquid Disposal Trench
- 116-DR-7 (105-DR) Inkwell Crib
- 132-DR-1 Waste Water Pumping Station.

116-DR-7 will be evaluated during the LFI by placing one vadose zone borehole through the waste site. 116-DR-3 will be evaluated during the LFI by excavating a test pit at the site. Limited field investigation geophysical surveys will be performed at the following sites: 116-DR-3, 116-DR-6, and 116-DR-7 in order to correctly locate these sites. The primary investigative activity for the remaining sites will be a review of historic records to further document the activities/usage at each site.

4.2.2.2 Investigations at Other High-Priority Sites. The LFI path leading to the IRM path, as shown in a logic diagram in Figure 4-3, is also proposed at other currently identified high-priority sites at the 100-DR-2 Operable Unit, as follows:

- Sodium Dichromate/Acid Pumping Station
- 118-D-5 Ball 3X Burial Ground.
- 118-D-1 100-D Burial Ground No. 1
- 118-D-2 100-D Burial Ground No. 2
- 118-D-3 100-D Burial Ground No. 3
- 118-D-4 Construction Burial Ground
- 118-DR-1 105-DR Gas Loop Burial Ground
- 128-D-1 100-D/DR Burning Pit

A test pit excavation is the proposed intrusive investigation activity for the sodium dichromate/acid pumping station. Geophysical surveys are proposed for 118-D-3 and 118-D-5 to locate the sites.

4.2.2.3 Sites Deferred to Final Remedy. The 126-DR-1 (190 DR Clearwell Tank Pit) and 1607-D-3 and 1607-D-1 (Septic Tanks and associated Drain Field) facilities have been deferred to the final remedy strategy.

4.2.2.4 Investigations at Decommissioned Facilities. Data will be reviewed for facilities already decommissioned, as shown in a logic diagram in Figure 4-4, to determine if further investigation is needed.

4.2.2.5 Investigations at Existing Facilities Proposed for Decommissioning. Investigations are not planned at facilities proposed for decommissioning, including the 118-DR-2 Reactor Building and associated fuel storage basin, and the 132-DR-2 Reactor Exhaust Stack. These facilities are deferred to the decommissioning program.

4.2.2.6 Investigations at Low-Priority Facilities. Low-priority facilities include septic tanks, electrical facilities, and support facilities where contamination is not suspected. Investigations proposed in this work plan under the past-practice strategy preliminary investigation will, in general, be limited to evaluation of existing data and a site walkover. Any field activities for low-priority sites will be deferred until the final remedy selection phase for the operable unit (see Figure 4-1). Future sampling of inactive septic tanks and placing a minimum of one shallow borehole or trench in each active or inactive tile field is recommended. The need for long-term investigations at electrical facilities will be determined by reviewing records for historic PCB equipment locations and associated possible PCB contamination, and data from analogous sites. Further investigations at support facilities where contamination is not suspected will be dependent upon the results of the site walkover and data compilation.

4.2.3 100-DR-2 Operable Unit Sampling and Analysis Approach

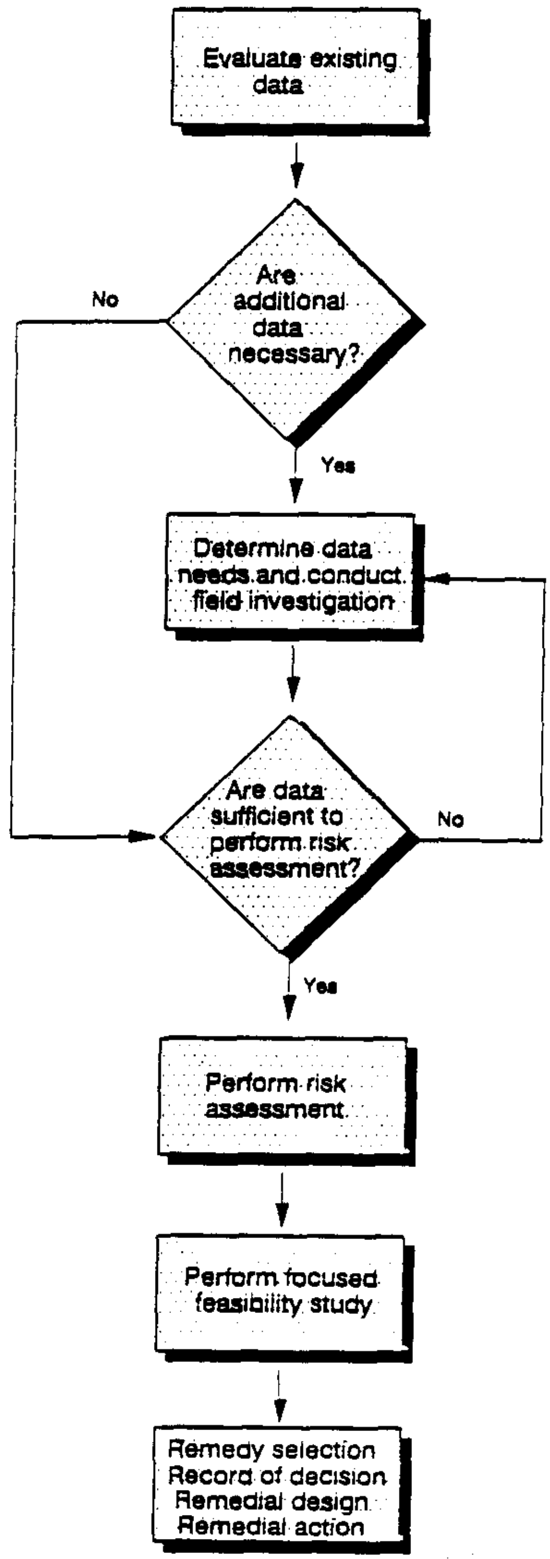
A primary assumption made for this work plan is that investigations can be limited in scope by employing the observational approach during implementation of interim actions. During the rescoping effort, it was agreed that limited data on the nature and vertical extent of contamination are needed for priority source areas. It was agreed that for most sites, one borehole, at a location likely to represent "worst case" conditions is sufficient to determine the nature and vertical extent of contamination. These investigations, including the number and locations of boreholes were identified in Section 4.2.1.2. Lateral extent of contamination and complete characterization is not required, as these data can be obtained either during the focused FS or during implementation of the IRM.

4.2.3.1 Source Sampling and Analysis. Depth of vadose zone borings will be based on field screening results (Section 5.1.1.5), where screening techniques are available for the contaminants expected to be present (i.e., radioactive and/or volatile organic compounds). At these sites, borings will extend to 1.5 m (5 ft) below detectable contamination to permit the collection of one sample to verify that the vertical extent of contamination has been defined. If screening continues to indicate detectable contamination to the water table, the boring will go below the water table to permit collection of at least one sample of the aquifer matrix. If screening techniques are not available or adequate relative to the criteria necessary to trace the extent of contamination, the boring will extend below the water table.

In the borings, samples will be collected at a maximum of 1.5 m (5 ft) intervals. Source samples will also be collected. For this investigation, a reduced analyte list is being used. Unless field screening results indicate the presence of volatile organics, no VOC analysis should be performed. Pesticide/PCB analyses should not be performed unless there is a reason to suspect their presence. Chemical analysis will be conducted using EPA contract laboratory program (CLP) methods. Standard methods will be used for radionuclide analysis. Routine analytical detection, quantitation limits, precision and accuracy will be specified in the QAPjP. As information is obtained from initial borings, and for borings at analogous facilities, a project-specific list of analytes will be determined. The reduced analyte list for borehole sampling is shown in Table 4-4. The reduced analyte list for test pit sampling is shown on Table 4-5.

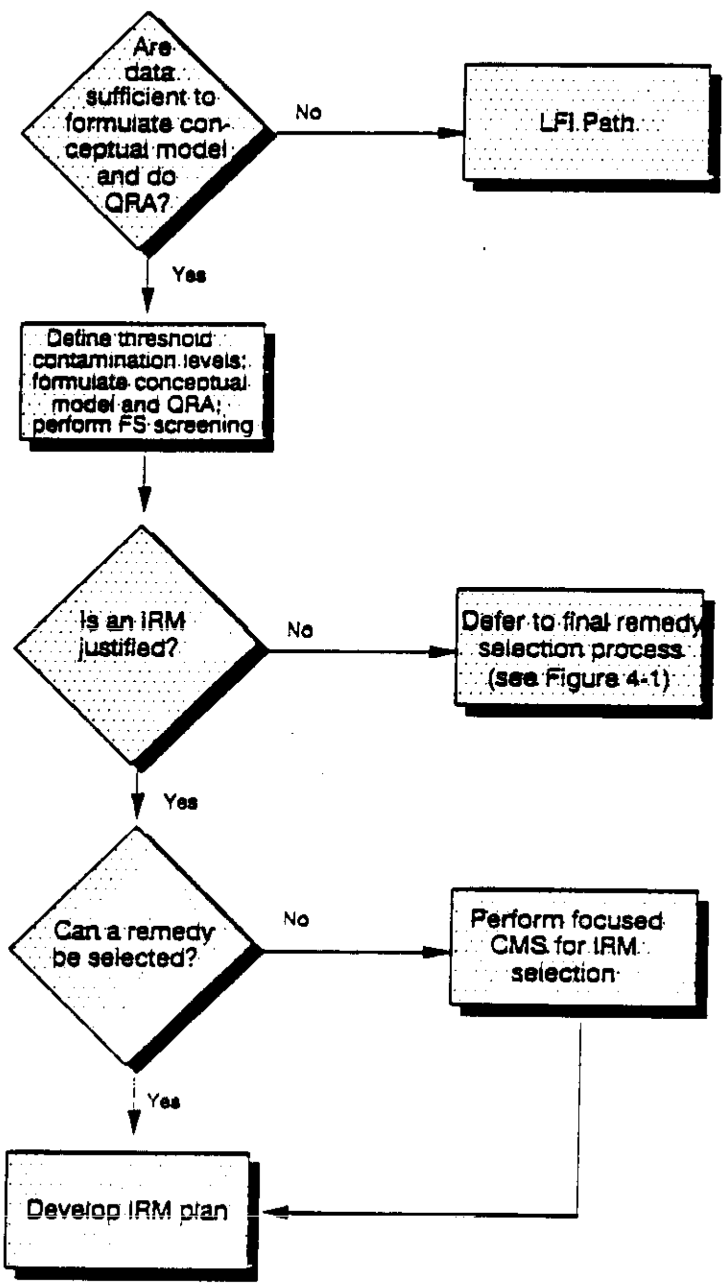
4.2.3.2 Data Validation Requirements. Validation will be done in accordance with Section 8.2 of the QAPjP (Appendix A).

Figure 4-1 Final Remedy Selection Process



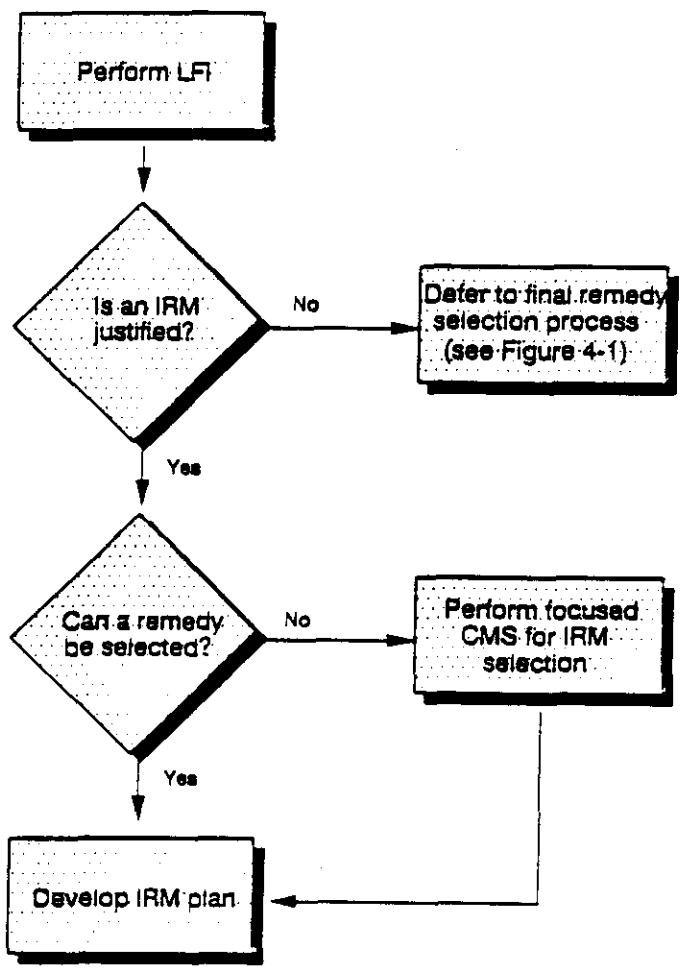
THIS PAGE INTENTIONALLY LEFT BLANK

Figure 4-2 Interim Remedial Measures Selection Process



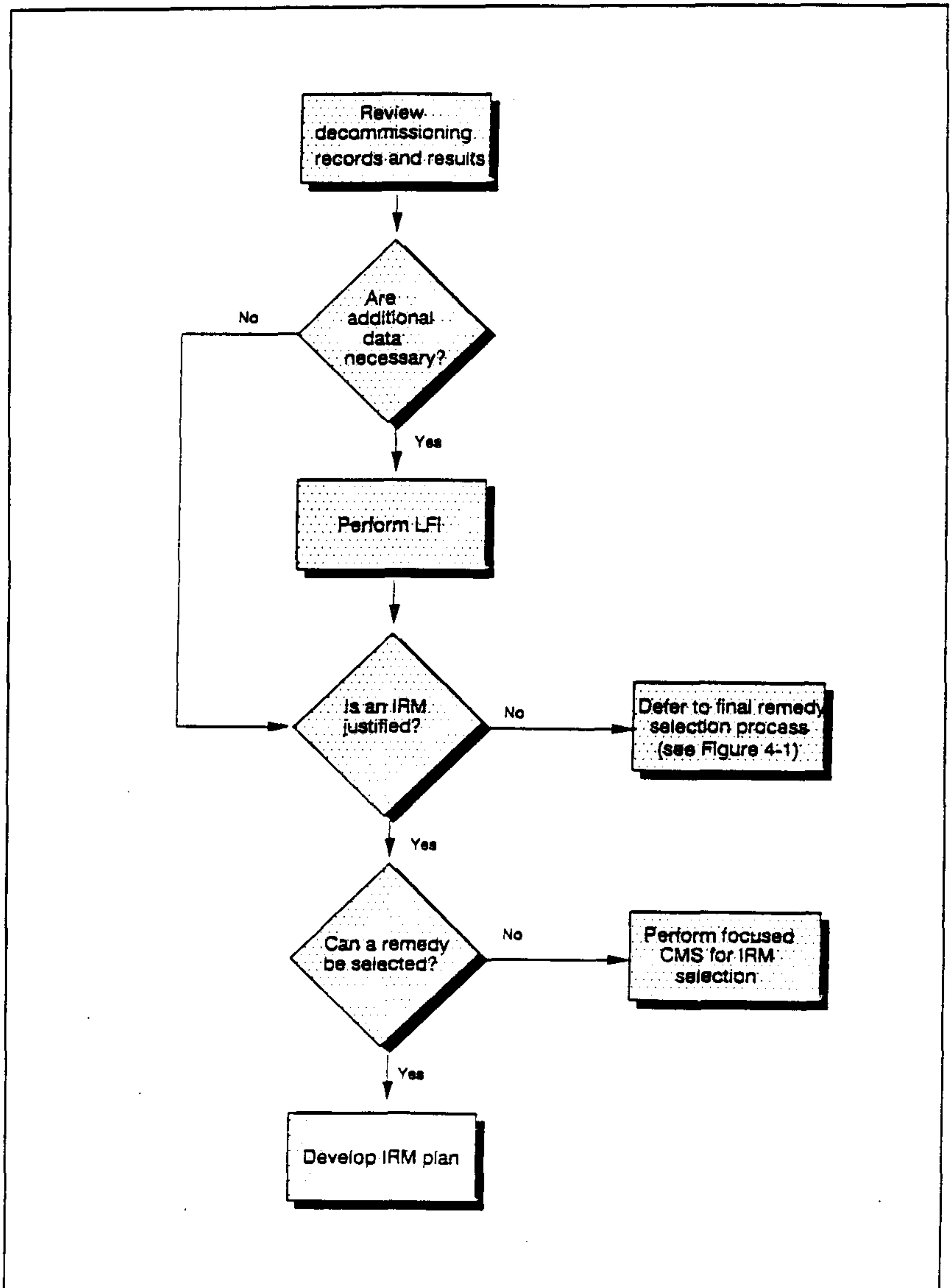
THIS PAGE INTENTIONALLY
LEFT BLANK

Figure 4-3 Investigations at High-Priority Liquid Waste Sites



THIS PAGE INTENTIONALLY
LEFT BLANK

Figure 4-4 Investigations at Facilities That Have Been Decommissioned



THIS PAGE INTENTIONALLY
LEFT BLANK

Table 4-1 Data Needs Summary (Page 1 of 3)

Data Needs	Purpose of Data					
	Refine Conceptual Operable Unit Model	Conduct Quantitative Baseline Risk Assessment	Conduct Qualitative Risk Assessment	Evaluate CARs	Conduct Focused Corrective Measures Study for IRM	Conduct Final Corrective Measures Study for Operable Unit
Source Data:						
• Locations and dimensions of all contaminant sources	S	S	S	S	S	S
• Types, quantities, and concentrations of contaminant sources	S	S	S	S	S	S
• Waste chemical and physical properties	S	S		S		S
Geologic Data:						
• Geological unit thickness and areal extent	S,G	S,G		S,G		S,G
• Soil mineralogy		H			H	H
• Stratigraphic features	S,G	S,G		S,G		S,G
Vadose Zone Data:						
• Soil/sediment types (classification)	S,G	S,G		S,G		S,G
• Saturated and unsaturated hydraulic conductivity[a]	S,G	S,G		S,G		S,G
• Moisture content	S,G	S,G				S,G
• Physical properties (grain-size, distribution, and bulk density)	S,G	S,G				S,G
• Soil chemistry and pH	S,G	S,G		S,G		S,G
• Contaminant concentrations and extent	S,G	S,G	S,G	S,G	S,G	S,G
• Soil/sediment lithology	S,G					S,G
• Depth to water table/thickness of vadose zone	S,G	S,G			G	S,G
• Infiltration[b]	H	H				H
Groundwater Data:						
• Nature and extent of contaminants in groundwater system	G	G	G	G	G	G
• River/aquifer interactions	A	A			A	A
• Hydraulic head in selected stratigraphic units	G	G			G	G

Table 4-1 Data Needs Summary (Page 2 of 3)

Data Needs	Purpose of Data					
	Refine Conceptual Operable Unit Model	Conduct Quantitative Baseline Risk Assessment	Conduct Qualitative Risk Assessment	Evaluate CARs	Conduct Focused Corrective Measures Study for IRM	Conduct Final Corrective Measures Study for Operable Unit
• Hydraulic properties	A,G,S	A,G,S			A,G,S	A,G,S
Surface Water and Sediment Data:						
• Nature and extent of contaminants in riverbank seeps, Columbia River and river sediments	A	A	A	A	A	A
Air Data:						
• Precipitation (annual and monthly averages and extremes; 1-hr and 24-hr max; PMP)	H	H		H		H
• Temperature (annual and monthly averages and extremes; days per year below freezing)	H	H		H		H
• Wind velocity and direction (monthly/seasonal averages and extremes)	A	A		A		A
• Barometric pressure	H	H				H
• Relative humidity	H	H				H
• Evaporation rate (monthly averages)	H	H				H
• Atmospheric stratification and inversions (duration and frequency)	H	H				H
• Magnitudes and frequencies of extreme weather events	H	H				H
• Air quality	S^c	S^c	S^c	S^c		S^c
Ecological Data:						
• Terrestrial vegetation wildlife potentially affected by source or groundwater contamination	A	A	A	A	A	A
• Presence of critical habitats	A	A	A	A	A	A
• Biocontamination	A	A	A	A	A	A
• Receptor demographics	A	A	A	A	A	A
• Land use characteristics; existing and potential future uses	A	A	A	A	A	A
• Water use characteristics; existing and potential future uses	A	A	A	A	A	A

Table 4-1 Data Needs Summary (Page 3 of 3)

Data Needs	Purpose of Data					
	Refine Conceptual Operable Unit Model	Conduct Quantitative Baseline Risk Assessment	Conduct Qualitative Risk Assessment	Evaluate CARs	Conduct Focused Corrective Measures Study for IRM	Conduct Final Corrective Measures Study for Operable Unit
Cultural Resource Data:						
• Location of surficial archaeological sites	A			A		A
• Presence of historic or archaeological sites that may be eligible for the National Register of Historic Places	A			A		A

[a] A range of unsaturated hydraulic conductivity values will be developed bounded by the saturated hydraulic conductivity and laboratory values of unsaturated hydraulic conductivity from tests on selected vadose zone samples.
[b] A range of infiltration values will be developed using current Hanford literature, studies such as the Hanford Protective Barrier Program, and actual site surface conditions.
[c] No field activities except routine health and safety monitoring.

Note:
CAR = Corrective action requirement
PMP = Probable maximum precipitation
S = Source operable unit investigation
G = Groundwater operable unit investigation
H = Hanford site-wide studies
A = Aggregate area studies

THIS PAGE INTENTIONALLY
LEFT BLANK

Table 4-2 Data Quality Objectives

Objectives	Determine nature and vertical extent of contamination.								
Prioritized Data Uses	Determine maximum contaminant concentration to support qualitative risk assessment. Define vertical distribution of contaminants in soil. Determine IRM action.								
Appropriate Analytical Level	Level II Field Screening CLP (Level IV) Methods EPA (Level III) SW-846 Methods								
Target Analytes (Level II Screen)	Chromium, gross beta, and gross gamma								
Level of Concern	Two times background[a]								
Required Detetion Limit	Two times background								
Target Analytes (Level III)	Cr	Co-60[c]	Cs-137[c]	Cs-134[c]	Eu-152[c]	Eu-154[c]	H-3[c]	Pu-239/240[c]	Sr-90[c]
Level of Concern	400[d]	51[e]	27[e]	19[e]	360[e]	250[e]	14,000[e]	3.5[e]	21[e]
Minimum Detection Limit[f,g]	40	5.1	2.7	1.9	36	25	1,400	1.0[g]	2.1
Critical Samples	One sample at expected waste depth. Two clean samples below lowest contamination. One sample at highest level detected during value screening.								

[a] = Background is from uncontaminated area near site.
[b] = Mg/Kg
[c] = pCi/g
[d] = HQ valie
[e] = Based on 10^{-6}
[f] = 0.1 of level of concern value
[g] = 0.1 of level of concern value

Cr = Cromium
Co = Cobalt
Cs = Cesium
Eu = Europium
H = Hydrogen
Pu = Plutonium
Sr = Strontium

THIS PAGE INTENTIONALLY
LEFT BLANK

Table 4-3 100-DR-2 Investigation (Page 1 of 5)

Site (Alias)	Comments	Investigation Approach	Pathway/Boreholes (Test Pit)	Rationale
High Priority Sites				
116-D-8 (100-D Cask Storage Pad)	Active from 1946-1975. Facility has 2 drainage systems; one for storm water and one for spillage. Spillage was handled by disposal through a french drain. The storage pad was decontaminated by removing portions of the concrete. The concrete chips were reported disposed of in the 200 Areas. Rinse water was disposed of adjacent to the pad in an area currently marked "Underground Radioactive Material."	Identify number and volume of spills that occurred on the pad. Site to include adjacent site posted as underground rad. Geophysics will be used to aid in location of french drain and evaluation of site.	IRM/0	The waste at this site is a result of leaks and spills that occurred on the pad. The site has already undergone a partial cleanup.
116-DR-3 (105-DR Storage Basin Trench)	This site was active during 1955, received 4,000,000 L of contaminated sludge and water from the 105-DR Fuel Storage Basin.	Geophysical survey using GPR of EMI to ascertain the presence and nature of materials used to fill the trench. One vadose zone test pit in a location determined by the geophysical survey.	LFI-IRM/1	This site has an HRS score of 40.09 and is considered a high-priority site. Previous sampling revealed the presence of radionuclide contamination at this site.

Table 4-3 100-DR-2 Investigation (Page 2 of 5)

Site (Alias)	Comments	Investigation Approach	Pathway/Boreholes (Test Pit)	Rationale
116-DR-4 (105-DR Pluto Crib)	116-DR-4 was active from 1952-1953, and received 4,000 L of liquid wastes from isolated tubes containing ruptured fuel elements in the 105-DR Fuel Storage Basin.	No LFI activity is planned for this facility as it is analogous to 116-D-2A.	IRM/0	This site has an HRS score of 9.13. The constituents present should be the same as those for 116-D-2A and thus the cleanup will use the results of 116-D-2A to define a remedial action.
116-DR-6 (1608-DR Liquid Disposal Trench)	The site was active from 1953-1965, received 7,000,000 L of diverted coolant during the Ball 3X upgrade. It also received diverted water during reactor shutdown.	LFI will be limited to currently locating the trench. This site is analogous to 116-DR-1 and 116-DR-2.	LFI-IRM/0	This site has an HRS score of 42.32. The constituents present should be the same as those for 116-DR-1 and 116-DR-2 and thus the cleanup will use the results of 116-DR-1 and 116-DR-2 to define a remedial action.
116-DR-7 (105-DR Inkwell Crib)	The site was active during 1953, received 4,000 L of liquid potassium borate from the 3X System prior to the Ball 3X System upgrade. There is reason to believe the site may be a storage tank rather than a crib.	LFI should consist of geophysical surveys to determine if the facility is a crib or a storage tank. If surveys indicate it is a crib then a single borehole should be drilled to characterize the crib.	LFI-IRM/1	This site has an HRS score of 28.96. The waste received at this site came from the 3X System prior to the Ball 3X System upgrade.

Table 4-3 100-DR-2 Investigation (Page 3 of 5)

Site (Alias)	Comments	Investigation Approach	Pathway/Boreholes (Test Pit)	Rationale
116-DR-8 (117-DR Crib)	The site was active from 1960-1964, received 240,000 L of drainage from the containment system 117 Building Seal Pits. From 1972-1986, supported the 105-DR Sodium Fire Facility.	Research/identify waste(s) that were placed in crib. Determine if wastes exhibit extraordinary contamination problems; should this be the case, further field investigations will be implemented.	LFI-IRM/0	This site has an HRS score of 0.0. Data determined during research will determine if field investigations are necessary.
132-DR-1 (1608-DR Waste Water Pumping Station)	The site was active from 1950-1964, received low level liquid waste. Unit consisted of an above ground structure and a below grade structure.	Research WIDS specific files to determine if any leaks occurred at this facility; if leaks occurred, determine volume, number, etc.	LFI-IRM/0	This site has been decommissioned.
Sodium Dichromate Tanker Car Off-Loading Facility	Possibly a source of contamination. Located north of the railroad tracks on the northern boundary of the operable unit.	Vadose zone test pit to ascertain the distribution and quantity of sodium dichromate in the vadose zone.	LFI-IRM/1	This is a significant waste site because undiluted volumes of sodium dichromate and acid solutions were disposed directly to the soil column.
Solid Waste Burial Grounds				
118-D-5 (Ball 3X Burial Ground)	Site was active during 1954, received 10 cubic meters of thimbles removed from the 105-DR Reactor during Ball 3X work.	Locate using geophysical methods.	LFI-IRM/0	The potential for solid waste to migrate is very small.

Table 4-3 100-DR-2 Investigation (Page 4 of 5)

Site (Alias)	Comments	Investigation Approach	Pathway/Boreholes (Test Pit)	Rationale
126-DR-1 (190-DR Clearwell Tank Pit)	This site has been active since 1970's as a landfill. The waste is nonhazardous, nonradioactive. The unit is an excavated area between 183-DR and 190-DR. Approximately 25% of the bottom surface contains a layer of waste 1.5 to 3.0 m deep that is covered with backfill.	Research and determine if "recent" disposal activities have occurred, if so, volumes, period of time, etc. The site will not be included in work plan if active status.	Defer/0	The potential for solid waste to migrate is very small.

Table 4-3 100-DR-2 Investigation (Page 5 of 5)

Site (Alias)	Comments	Investigation Approach	Pathway/Boreholes (Test Pit)	Rationale
		Low-Priority Facilities		
1607-D-3 (Septic Tank and Associated Drain Field)	Site was started in 1944 and is currently active; receives sanitary waste from the 151-D Electrical Distribution Substation. The flow rate of this unit is estimated at a maximum of 3,975 L/day.	No intrusive activities are planned, action is deferred pending resolution of common septic system approach.	Defer	Potential for hazardous or radioactive contamination is very small.
118-DR-2 (105-DR Reactor Building)	Site was active from 10/3/50 through 12/30/64; contains an estimated 13,500 Ci of radionculides, 85 metric tons of lead, 3 cubic meters of asbestos and 500 pounds of cadmium.	N/A	Defer	The potential for solid waste to migrate is very small.
122-DR-1 (105-DR Sodium Fie Facility)	Site was active from 1972-1986; site wastes consist of sodium, lithium, and sodium potassium alloy. Approximately 20,000 Kg are managed at this facility each year. The facility also stores up to 20,000 L of dangerous wastes.	RCRA TSD facility; coordinate with closure Part A Permit, Part B Permit; interim closure plan has been submitted for this site.	Defer	
132-DR-2 (116-DR Reactor Exhaust Stack)	The site was active from 1950-1986; waste is solid low-level waste. The unit is a monolithic, reinforced concrete structure with a maximum wall thickness of .46 m at the base.	N/A	Defer	The potential for solid waste to migrate is very small.

HRS = hazard ranking system
IRM = interim remedial measure
LFI = limited field investigation
defer = these sites will be addressed with the final remediation of the site.

THIS PAGE INTENTIONALLY
LEFT BLANK

Table 4-4 Borehole Sampling Contaminants of Concern

ANALYTE	METHOD	HOLDING TIME	CONTAINER/VOLUME
GENERIC			
ICP/AA Metals	200.7 CLP-H[a]	6 mo	Glass, 500 mL
Mercury	245.1 CLP-H, 245.1 CLP-H	28 d	
ANIONS/IC:			
Fluorides	EPA 300[b]	28 d	Glass/plastic 250 mL
Sulfates	EPA 300[b]		
Nitrates, nitrites	EPA 353.2		
TMA			
Gross alpha	EA-10	6 mo	Glass/plastic, 1,000 mL
Gross beta	EA-10		
Gamma spec	RC-30		
Strontium-90	RC-306, RC-303, RC-309 RC-304		
WESTON			
Gross alpha	PRO-032-15	6 mo	Glass/plastic, 1,000 mL
Gross beta	PRO-032-15		
Gamma spec	PRO-042-5		
Strontium-90	PRO-032-38 PRO-032-25		
222-S LABORATORY			
Total Activity	Prep: LA-548-111	24 h	Plastic or glass, small vial (at least 1 g)
	Procedure:LA-508-121		

AA = atomic absorbtion
IC = ion chromatography
ICP= inductively coupled plasma
[a]modified for the Contract Laboratory Program
[b]Modified (Lindahl 1984)

THIS PAGE INTENTIONALLY
LEFT BLANK

Table 4-5 Test Pit Sampling Contaminants of Concern

ANALYTE	METHOD	HOLDING TIME	CONTAINER/VOLUME
ICP/Metals	SW-846	6 mo	Glass, 250 mL
Mercury	SW-846	28 d	
ANIONS			
Sulfate	EPA 300[a]	28 d	Glass/Plastic 250 mL
Fluoride	EPA 300[a]	28 d	
Nitrate/nitrite	EPA 353.2	28 d	
RADIONUCLIDES			
Strontium-90	Lab SOP	6 mo	Glass or plastic, 1,000 mL
Gross alpha	Lab SOP	Lab SOP	
Gross beta	Lab SOP	Lab SOP	
Gamma spec	Lab SOP	Lab SOP	
Total activity (222-S Lab)	Lab SOP	6 mo	Glass or plastic small vial (at least 1 g)

[a]EPA 300/Modified per work plan quality assurance project plan.
AA = atomic absorbtion
ICP = inductively coupled plasma
SOP = standard operating procedure

THIS PAGE INTENTIONALLY
LEFT BLANK

5.0 RCRA FACILITY INVESTIGATION/CORRECTIVE MEASURES STUDY PROCESS

This chapter describes the RFI/CMS process through the final RFI and final CMS for the operable unit. Section 5.1 outlines the tasks to be implemented during the LFI and the 100 Area aggregate and Hanford Site studies, and during the final RFI. Tasks are designed to provide information needed to meet the DQO identified in Chapter 4. The detailed information necessary to carry out these tasks for field activities, if needed, will be presented in descriptions of work (DOW) for the operable unit (see Subtask 1e). Environmental monitoring requirements for protecting the health and safety of onsite investigators are described in the Health and Safety Plan (HSP) (Appendix B).

The feasibility and corrective measures studies that will be conducted in support of remedy selections during the RFI/CMS process are described in Section 5.2. A detailed analysis of remedial alternatives for IRM will be conducted as part of the focused FS, and an analysis for operable unit corrective actions will be conducted as part of the final CMS. Both the focused FS and final CMS will use information provided by the analysis of generic remedial alternatives completed as part of the *100 Area Feasibility Study, Phases 1 and 2* (DOE-RL 1992d).

Following approval, this work plan will not be modified. Any changes to the scope of work that may be needed will be documented through change requests.

5.1 RCRA FACILITY REMEDIAL INVESTIGATION PROCESS

5.1.1 Limited Field Investigation and the 100 Area Aggregate and Hanford Site Studies

To satisfy the data needs and DQO specified in Chapter 4.0, the following tasks will be addressed during the LFI:

- Task 1 - Project Management
- Task 2 - Source Investigation
- Task 3 - Geological Investigation
- Task 4 - Surface Water and Sediments Investigation
- Task 5 - Vadose Zone Investigation
- Task 6 - Groundwater Investigation
- Task 7 - Air Investigation
- Task 8 - Ecological Investigation
- Task 9 - Other Tasks
- Task 10 - Data Evaluation
- Task 11 - Risk Assessment
- Task 12 - Verification of CAR
- Task 13 - LFI Report.

The tasks and their component subtasks and activities are outlined in the following sections. Information is provided on each task to allow estimation of the project schedule (see Section 6.0) and costs.

5.1.1.1 Task 1 - Project Management. The project management objectives throughout the course of the 100-DR-2 Operable Unit RFI/CMS are to direct and document project activities so that the data and evaluations generated meet the goals and objectives of the work plan, and to ensure that the project is kept within budget and schedule. The initial project management activity will be to assign individuals to roles established in Chapter 7.0. Specific subtasks that will occur throughout the LFI/Focused FS and RI/FS include the following:

- Subtask 1a - General Management
- Subtask 1b - Meetings
- Subtask 1c - Cost Control
- Subtask 1d - Schedule Control
- Subtask 1e - Work Control
- Subtask 1f - Records Management
- Subtask 1g - Progress and Final Reports
- Subtask 1h - Quality Assurance
- Subtask 1i - Health and Safety
- Subtask 1j - Community Relations.

Each of these subtasks are described in the following sections. Further detail on schedule control, cost control, meetings, and reporting can be found in the DOE-RL (1989) Environmental Restoration Field Office Management Plan and the Action Plan in the Tri-Party Agreement (Ecology et al. 1990a).

5.1.1.1.1 Subtask 1a - General Management. This subtask includes the day-to-day supervision of, and communications with, project staff and subcontractors. Throughout the project, daily communications, between office and field personnel will be maintained, along with periodic communications with subcontractors, to assess progress and to exchange information. This constant exchange of information will be necessary to assess the progress of the project and to identify problems early enough to make necessary corrections to keep the project focused on its objectives, on schedule, and within budget.

5.1.1.1.2 Subtask 1b - Meetings. Meetings will be held, as necessary, with members of the project staff, subcontractors, regulatory agencies, and other appropriate entities (particularly those involved with the nearby 100 Area operable units and reactor decommissioning projects) to communicate information, assess project status, and resolve problems. Monthly unit managers' meetings will be held to report progress, resolve problems, and address changes in work scope, as necessary.

Operable unit project coordinators for this and other operable units will meet periodically to share information and to discuss progress and problems. The frequency of other meetings will be determined based on need and on schedules published in the Tri-Party Agreement Action Plan (Ecology et al. 1990a).

5.1.1.1.3 Subtask 1c - Cost Control. Project costs, including labor, other direct costs, and subcontractor expenses, will be tracked monthly. The budget tracking activity will be computerized and will provide the basis for invoice preparation and review, and for preparation of progress reports.

5.1.1.1.4 Subtask 1d - Schedule Control. Scheduled milestones will be tracked monthly for each task for each phase of the project. This will be performed in conjunction with cost tracking.

5.1.1.1.5 Subtask 1e - Work Control. The level of detail provided in this work plan is adequate for initial planning purposes. Detailed information needed to carry out the investigative tasks discussed in this chapter will be provided in the 100-DR-2 Source Operable Unit DOW. The DOW will be provided to the lead regulatory agency for review and approval. Where appropriate, the DOW will reference WHC EII from the Environmental Investigations and Site Characterization Manual, (WHC 1988) rather than listing the entire procedure for a task. Environmental Investigation Instructions for field activities and laboratory analysis are also referenced in the QAPjP (Appendix A). Any reference to the DOW or QAPjP as a source of additional information is inclusive of the EII they reference.

The DOW shall be prepared in accordance with the procedures listed in the QAPjP. The DOW must satisfy the following requirements:

- Include a scope of work introductory section.
- Include the DQO, as specified in the work plans, for each type of activity.
- Identify the proposed locations for sampling and the criteria for selecting those locations. A map, at a scale appropriate to locate the sites in the field, should be included.
- Identify any field screening activities not described in the work plan or in the relevant EII. Identify any field screening equipment to be used which is not described in the relevant EII.
- Include the frequency of measurements (e.g., five foot intervals and lithology breaks).
- Identify the applicable EII needed to conduct the work. If an EII includes several different ways to accomplish the work, then the DOW should specify the method of choice or reference the specific EII section.
- Identify any calibrating standards and frequencies not included in the relevant EII.

- Describe any data collection procedures, chain of custody procedures, sample container size and preparation, holding times, type of analysis, number of split samples, number of duplicate samples, number of blank samples and data reporting requirements not included in the relevant EII.

- Provide an estimate of the proposed field activity schedule, including sampling periods.

- Include provisions to document any field changes using a project change form and submit the form to EPA/Ecology within 10 working days of the change.

5.1.1.1.6 Subtask 1f - Records Management. The project file will be kept organized, secured, and accessible to the appropriate project personnel. All field reports, field logs, health and safety documents, quality assurance/quality control (QA/QC) documents, laboratory data, memoranda, correspondence, and reports will be logged into the file upon receipt or transmittal. This subtask is also the mechanism for ensuring that data management procedures documented in the Information Management Overview (IMO) (Appendix C) are carried out appropriately.

5.1.1.1.7 Subtask 1g - Progress and Final Reports. Monthly progress will be documented at unit managers' meetings. Meeting minutes will be prepared, distributed to the appropriate personnel and entities (e.g., project and unit managers, coordinators, contractors, subcontractors), and entered into the project file. Other reporting requirements (e.g., DOE quarterly progress reports) are discussed in Chapter 7.0.

All LFI/Focused FS and RFI/CFS reports and plans will be categorized as either primary or secondary documents. The process for document review and comment is covered by the Tri-Party Agreement Plan (Ecology et al. 1990a). Administration records must be maintained, as described in Section 9.4 of the Action Plan.

5.1.1.1.8 Subtask 1h - Quality Assurance. The specific planning documents required to support the LFI/Focused FS and RFI/CMS have been developed within the overall QA program structure mandated by the DOE for all activities at the Hanford Site. Within that structure, the documents are designed to meet current EPA guidelines for format and content and are supported and implemented through the use of standard operating procedures drawn from the existing program or that have been developed specifically for environmental investigations. To ensure that the objectives of this RFI/CMS are met in a manner consistent with applicable DOE guidelines all work conducted by WHC will be performed in compliance with existing QA manuals and the WHC QA program plan that specifically describe the application of manual requirements to environmental investigations. The 100-DR-2 Operable Unit QAPjP (Appendix A) supports the LFI described in this chapter. The QAPjP defines the specific means that will be used to ensure that the sampling and analytical data are defensible and will effectively support the purposes of the investigation. The QAPjP will be implemented by this subtask.

5.1.1.1.9 Subtask 1i - Health and Safety. The HSP (Appendix B) will be used to implement standard health and safety procedures for WHC employees and contractors engaged in RFI/CMS activities in the 100-DR-2 Operable Unit.

5.1.1.1.10 Subtask 1j - Community Relations. Community relations activities will be conducted in accordance with the *Community Relations Plan for the Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1990b). All community relations activities associated with the 100-DR-2 Operable Unit will be conducted under this overall Hanford Site Community Relations Plan (CRP).

5.1.1.2 Task 2 - Source Investigation. The source investigation for the LFI at the 100-DR-2 Operable Unit is composed of five subtasks and their component activities:

- Subtask 2a - Source Data Compilation and Review

- Subtask 2b - Surveying

- Subtask 2c - Field Activities
  - Activity 2c-1 - Site Walkover
  - Activity 2c-2 - Surface Radiation Survey
  - Activity 2c-3 - Source Sampling

- Subtask 2d - Laboratory Analysis and Data Validation

- Subtask 2e - Source Data Evaluation.

These subtasks will be conducted to identify sources, locations, and potential contamination associated with each high-priority facility and identified low-priority sites as agreed to by the three parties. Additional activities described under Task 5, Vadose Zone Investigation, will be conducted to define the nature of soil contamination. As described in the following subtasks, not all activities will be conducted at each facility.

The source investigation performed as part of the 100-DR-2 Source Operable Unit investigation will be integrated with similar investigations to be performed as part of the 100-HR-3 Groundwater Operable Unit investigation to avoid duplication of effort and maximize use of the data obtained.

5.1.1.2.1 Subtask 2a - Source Data Compilation and Review. A search for the 100-DR-2 Operable Unit documents, photographs, and drawings is currently underway. A review of this material was used to provide additional information about source units or potential source areas in order to focus all subsequent investigative tasks and subtasks. The source data compilation subtask consists of reviewing the existing information on 100-DR-2 Operable Unit facilities to more accurately and completely characterize the potential sources of contamination within the operable unit. Historians are also conducting interviews and document searches to compile information related to the operations conducted in the 100-DR-2 Operable Unit.

This compilation will provide additional information on the history of operations of the reactor and support facilities, as well as the waste generation processes, solid and liquid waste streams, waste facility characteristics, radioactive and hazardous waste storage volumes and inventories, and exact location and construction specifications for facilities for which information is currently lacking. Some or all of this information is needed to supplement information for facilities listed on Table 2-1 of the work plan that are identified as known or suspected to have received or produced radioactive or hazardous wastes, or for which waste receipt or production is currently unknown. The above information is necessary to more accurately and completely characterize the potential sources of contamination at the operable unit and to further characterize the physical and ecological setting. The information obtained in this subtask will be evaluated and subsequently used to refine the 100-DR-2 Operable Unit conceptual model, and support the QRA.

The available historical documents, including aerial photographs, engineering plans, environmental or decommissioning reports, effluent discharge reports, daily and monthly reactor operating logs, and environmental release reports not evaluated during this scoping process will be reviewed. This subtask may also include interviews with those personnel having knowledge of past activities, including former and current operations, decommissioning, and maintenance personnel. Records from the PCB programs, performed under Section 3, Asbestos and PCB, *Environmental Compliance Manual* (WHC 1991b), in accordance with (40 CFR 761), will be reviewed to investigate possible past-practice PCB leaks.

Any data gathered during LFI at analogous waste units within the other 100 Area operable units will be compiled. These data will be evaluated to determine applicability to analogous waste units in the 100-DR-2 Operable Unit.

5.1.1.2.2 Subtask 2b - Surveying. The objectives of this activity are to provide horizontal and vertical control for sampling points and to document all sample-point locational data on an operable-unit-wide basis. A topographic base map for the operable unit has been developed using computer aided design at a scale of 1:2,000 that shows elevation contours at 0.5 m (1.5 ft) intervals. Horizontal control will be provided for sampling points established for completing the sampling at low-priority sites. The topographic base map will provide adequate horizontal and vertical control for source samples. Subtask 2b, surveying, will continue throughout the field program. A list of supporting procedures for surveying is presented in Table QAPjP-2 in the QAPjP.

5.1.1.2.3 Subtask 2c - Field Activities. Three field activities are planned for the 100-DR-2 Operable Unit. These activities are:

Activity 2c-1 - Site Walkover. This activity will be conducted during the LFI at low-priority facilities deferred to the final remedy selection process. The objectives of this activity are to identify and locate additional sources and areas of disturbed and/or unnatural appearance, to locate known (but misplaced) sources, and to obtain a general understanding of the site with emphasis on those facilities deferred to the long-term final remedy selection process. The entire operable unit will be walked, and areas of disturbance, monuments, old foundations, and so forth, will be mapped. The walkover will be extended outside the operable unit boundary if it is determined that previously unidentified source units are present near the operable unit. Available aerial photographs will be used by the crew performing the walkover. The crew will note areas of potential interest on the photographs and will ground-truth unusual areas noted on the photographs. All areas of potential interest will be flagged and surveyed as part of Subtask 2b - Surveying.

Activity 2c-2 - Surface Radiation Survey. The surface radiation survey will be used to identify areas of surface, and potentially, subsurface radioactive contamination that will require further study.

Surface radiation will be measured by using portable alpha detectors and sodium-iodine beta/gamma detectors that read in cpm. Radiation detection equipment will be either a manual (hand-held) system or a computer-based integrated system using vehicle-mounted or backpack-mounted detectors. The survey will identify any currently unknown areas of surface radiation contamination. A background plot will not be established for the 100-DR-2 Operable Unit because a 2,750 m^2 (25,000 ft^2) area was selected outside of the 100-DR-1 Source Operable Unit boundary, based on the absence of radiation related operations and an initial survey. A map of the survey plot and the results are included in Appendix C. This area will be used for determining ambient background surface radiation levels related to the 100-DR-2 Operable Unit. Methods used to conduct the background measurements will be the same as those used within the operable unit.

If a manual radiation detection system is used, the survey will be conducted on 8 m (25 ft.) spacing in all areas where no source units are known or suspected. The survey will consist of continuous readings collected along traverses 8 m (25 ft.) apart. The traverse spacing will be $<$ 8 m (25 ft.), as necessary, in anomalous areas noted during the area walkover survey. As a potentially cost-effective alternative to conducting the surface radiation survey entirely with portable (for example, hand-held) radiation detectors, an integrated vehicle-mounted and backpack-mounted computer based mapping system will be evaluated. If the integrated vehicle-mounted and backpack-mounted computer based radiation mapping system proves effective during tests, they will be used for the surface radiation surveys.

Areas with radiation statistically above background results will be staked and flagged for more-detailed investigation under Task 5, Vadose Zone Investigation. Each anomaly will be assigned a unique number. The statistical method for designating anomalies will be determined based on the type of equipment and counting array used. The exact technique, including statistical methods of designating anomalies, will be described before initiating the radiation survey. Procedures for performing the radiation survey are listed in Table QAPjP-2 in the QAPjP.

Activity 2c-3 - Source Sampling. At the 100-DR-2 Operable Unit, there are no plans to perform any source sampling.

5.1.1.2.4 Subtask 2d - Source Sample Laboratory Analysis and Data Validation. There are no plans proposed to perform source sampling, therefore there will be no requirements for laboratory analysis or data validation.

5.1.1.2.5 Subtask 2e - Source Data Evaluation. Additional existing information compiled under Subtask 2a, Source Data Compilation, will be evaluated, and any necessary changes to the planned work will be made. This compilation will include descriptions of each source with levels and types of contamination in the source. The information collected during Subtask 2c, Field Activities, will be compiled and evaluated to identify areas for more detailed soil investigation. Sampling locations will be plotted on the electronic site topography maps. Source sampling data will support the risk assessment.

5.1.1.3 Task 3 - Geologic Investigation. The purpose of the geologic investigation is to further characterize the geology of the operable unit. Because geological data needs overlap with those of the 100-DR-1 Operable Unit vadose zone investigations and the 100-HR-3 Groundwater Operable Unit, the geological investigation will require an integrated compilation of geologic information from both the source and groundwater operable units. For this reason, the geologic investigation will be performed as part of the 100-HR-3 Groundwater Operable Unit, and is described in Section 5.1.1.3 of that work plan (DOE-RL 1992a).

5.1.1.4 Task 4 - Surface Water and Sediments Investigation. No surface water and sediments are included within the boundaries of the 100-DR-2 Operable Unit. The subtasks for the surface water and sediments investigation for the 100-DR-2 Operable Unit were performed as part of an aggregate area investigation for the 100 Area, and are discussed in Appendix D-1, Surface Water and Sediment Investigation, of the 100-HR-3 Operable Unit Work Plan (DOE-RL 1992a).

5.1.1.5 Task 5 - Vadose Zone Investigation. The objective of this task is to define the nature and vertical extent of contamination related to waste disposal facilities at the 100-DR-2 Operable Unit, to define relevant migration paths between the disposal units and potentially contaminated media, especially groundwater, and to support the selection of IRM. On the basis of existing data and judgement, the lateral extent of the contamination below liquid waste facilities is expected to be limited to the size of the facility. The remediation will be performed using the observational approach; with this method the actual limits of lateral extent will be determined and remediated simultaneously. Data obtained during the LFI will be used for the following purposes:

- refining the conceptual model
- supporting a QRA for implementing IRM
- supporting a focused FS for developing and evaluating IRM alternatives.

To implement the *Hanford Past-Practice Strategy* (DOE-RL 1991a) with a bias for action, the investigation has been designed with an emphasis on the primary data needs for supporting the QRA and implementing IRM. However, some of the data needed for the QRA, the definition of ARAR, and the final FS will also be obtained.

The approach to the vadose zone investigations is to obtain information from test pit excavations and drilling conducted in this investigation and from drilling conducted for installation of monitoring wells in the 100 Area groundwater operable units. Information on the nature and vertical extent of contamination will be obtained from borings and test pit excavations in the priority liquid waste disposal facilities identified in Table 4-2. Additional vadose zone information can be obtained from the data collected during drilling of groundwater monitoring wells in the 100-HR-3 Operable Unit from the screening samples and cuttings and collecting samples if contamination was indicated. Samples will also be collected near the water table to determine contamination remaining as a result of past groundwater mounding or fluctuating groundwater levels. Physical properties of the vadose zone soils required to model fate and transport for the quantitative baseline risk assessment will be obtained from both source borings and boreholes for monitoring well installations throughout the 100 Area. This approach is described in more detail in Section 5.1.1.5.2.

The vadose zone soils investigation will consist of the following subtasks:

- Subtask 5a - Data Compilation
- Subtask 5b - Borehole Soil Sampling and Logging
- Subtask 5c - Test Pit Sampling
- Subtask 5d - Soil Sample Analysis
- Subtask 5e - Geophysical Borehole Logging/Geophysical Ground Penetrating Radar
- Subtask 5f - Data Evaluation.

5.1.1.5.1 Subtask 5a - Data Compilation. Data from the source data compilation task described in Task 2 and data from vadose zone investigations at other 100 Area operable units will be reviewed to determine whether any modifications are needed to the drilling and sampling activities. The Task 2 activities may identify additional facilities where a borehole is necessary to determine the need for an IRM, or to complete the quantitative risk assessment and final remedy selection for the operable unit. In addition, data collected from the most recent soils characterization effort at the Hanford Site (DOE-RL 1993c) will be reviewed. These data will be used for comparison with the vadose zone sampling data to determine presence of contamination.

5.1.1.5.2 Subtask 5b - Borehole Soil Sampling and Logging. Objectives of the boring and soil sampling activities include analyzing soils associated with the high-priority liquid waste disposal facilities in the 100-DR-2 Operable Unit. Final borehole locations will be approved by the unit managers and documented in the DOW. Borehole coordinates will be established by a survey following completion. Table 5-1 is a summary of the proposed vadose zone sampling locations, number of boreholes, number of samples, and types of analyses. One borehole will initially be drilled at the 116-DR-7 (105-DR) Inkwell Crib. Figure 5-1 shows the proposed borehole location for the 116-DR-7 site.

Borings may be necessary to support the final operable unit ROD at some of the low-priority facilities based on the results of Task 2 activities.

Boreholes will be advanced and sampled using cable tool drilling methods and split-spoon or core barrel samples. Cable tool drilling will be used for this task because of the gravels, cobbles and boulders common to the operable unit, and because the quantity of drilling residuals is minimal and can be easily controlled compared to other drilling methods. Other methods that provide essentially equal means of containing wastes and limiting spread of contamination may be considered. Procedures for borehole drilling, sample collection, handling, and analysis are listed in Table QAPjP-2 in the QAPjP.

Depth of the vadose zone borings will be based on field screening results. The use of the field screening instruments will be detailed in the DOW. Radiological screening is expected to be effective in determining the extent of contamination and depth of drilling for all the facilities identified for the initial boring activities at this operable unit. Organic vapor monitors and hexavalent chromium test kits may also be used for field screening. X-ray fluorescence (XRF) may be considered as an alternative method of metal contaminant screening. At these facilities, sampling for chemical analyses will be conducted at 1.5 m (5 ft) intervals, with drilling and sampling extending to 1.5 m (5 ft) beyond detectable contamination. This will permit the collection of a sample for laboratory analysis to verify that the vertical extent has been defined. If screening continues to indicate detectable contamination to the water table, the boring will extend below the water table to permit collection of at least one sample of the aquifer matrix.

Samples will also be collected for physical property data from one boring at the 116-DR-7. The data are needed for quantitative flow and solute transport analyses in the unsaturated zone for development of defensible risk analysis. The physical properties of the sediments at high-volume waste disposal facilities may have changed by solution of carbonates, the flushing of silt and clay-sized particles from the soil, or by the precipitation of iron complexes. A maximum of five samples will be collected. All samples for physical data will be collected during drilling, using a reinforced carbide-tipped core barrel. This technique will be used initially and as deep as is practical in these boreholes. Sampling will not be conducted for soil physical properties in intervals where the hard tool was used to advance the borehole. It is recognized that this sampling strategy will result in a biased or censured data set because cobbly soils cannot be effectively sampled by core barrel techniques, and hard tool drilling does not provide representative samples for these properties. However, the technique of hard tool drilling will only be used in intervals where core barrel drilling can no longer advance the borehole. Sample collection, handling and analysis for physical property analysis are discussed in Section 5.1.1.5.3, and procedures are listed in Table QAPjP-2 of the QAPjP. Specific procedures will be documented in the DOW.

All boreholes will be geologically logged, based on drill cuttings and the split-spoon or core samples taken at specified intervals. Borehole geologic logs will be prepared in accordance with procedures specified in the QAPjP and in the DOW. Drill cuttings and core samples will be screened with hand-held instruments for radiation and volatile organic compounds. Screening results and general observations as to drilling progress and problems will be included in each borehole log.

Soil cuttings containing unknown, low-level mixed radioactive waste and/or hazardous waste will be contained, stored, and disposed of according to Westinghouse Hanford Company procedures specified in Table QAPjP-2 of the QAPjP and as documented in the DOW.

All boreholes will be abandoned following completion of the geophysical logging described in Section 5.1.1.5.5. Specific procedures for borehole abandonment are identified in Table QAPjP-2 of the QAPjP and will be documented in the DOW. These procedures are written to comply with EPA requirements and Chapter 173-160 WAC.

5.1.1.5.3 Subtask 5c - Test Pit Sampling. The objective of using test pits is to provide a fast and relatively inexpensive method to characterize sites. Test pit sampling shall be conducted per Appendix I, "Test Pit/Trench Sampling" of EII 5.2, "Soil and Sediment Sampling" (WHC 1988). The bucket of the backhoe will be decontaminated before excavating each test pit. Soils will be field screened for radionuclides, organics, and hexavalent chromium. The samples shall be taken from the bucket before the excavated material is placed on the ground. A minimum of one, and maximum of two analytical samples shall be collected from each test pit utilizing field screening criteria. The first time the material does not pass the screening criteria, a sample shall be collected. Excavated test pit soil will be replaced in the test pit site after sampling is completed in the reverse order of the excavation and packed. Figure 5-1 shows the proposed location for the test pit excavation for the 116-DR-3 site and Figure 5-2 shows the proposed location for the test pit excavation for the Sodium Dichromate/Acid Pumping Station.

5.1.1.5.4 Subtask 5d - Soil Sample Analysis. For the initial borings/test pit excavations in the priority waste sites, a reduced suite of analyses will be conducted to determine the nature of contamination. Samples collected for chemical analysis will be analyzed for the TCL and target analyte list (TAL) constituents, for specific anions that may be present, using EPA (1986) Level IV methods (SW-846 methods will be used to analyze test pit samples, and CLP methods will be used to analyze vadose borehole samples for all analytes except radionuclides, which will be analyzed by standard methods as defined in the laboratory statement of work). Analysis of soils for hexavalent chromium will be performed using non-CLP methods. Analytical methods, routine analytical detection limits and quantitation limits, and precision and accuracy specified for the methods are provided in Table QAPjP-1 of the QAPjP and will be documented in the DOW.

Soil samples collected from the one high-volume liquid waste disposal facility will be tested for the following physical properties:

- moisture content American Society for Testing and Materials (ASTM D2216)
- bulk density
- particle-size distribution (ASTM D422-63)
- saturated hydraulic conductivity (K_{sat}) (ASTM D2434-68).

Analytical methods for the physical properties are identified in Table QAPjP-2 of the QAPjP and will be documented in the DOW.

5.1.1.5.5 Subtask 5e - Geophysical Borehole Logging/Ground Penetrating Radar. Geophysical logging will be performed in existing wells that may be located in contaminated areas. Prior to borehole abandonment, boreholes will be geophysically logged to provide additional characterization information to supplement the soil sampling data. The following logging techniques will be used:

- gross-gamma logging to identify confining layers and for stratigraphic correlation
- spectral-gamma logging for measuring the distribution of selected radionuclides.

The existing equipment and procedures for gross-gamma and spectral-gamma logging in use at the Hanford Site provide acceptable data. The procedures are specified in Table QAPjP-2 of the QAPjP and will be documented in the DOW. Gross gamma logging will be used only when spectral-gamma equipment is not available or when site conditions do not allow its use.

Ground penetrating radar (GPR) or an analogous type of survey method (e.g., electro-magnetic inductance [EMI]) will be performed at four sites (116-D-3, 116-DR-4, 116-DR-6, and 118-D-5). The purpose of the surveys to be performed at sites 116-DR-6 and 118-D-5 is to accurately locate these sites. The purpose of the survey to be performed at 116-DR-3 is to ascertain the presence and nature of materials used to fill the trench. The survey to be performed at 116-DR-7 is to determine if the facility is a crib or a storage tank.

5.1.1.5.6 Subtask 5f - Data Evaluation. This task will include evaluating all the information collected during the vadose zone investigation. The emphasis of the evaluation will be to determine whether an IRM should be conducted at the high-priority sites. The data may also be used to determine what is to be done at analogous facilities at other operable units. Chemical data will be evaluated and compared to CAR and soil background data. Borehole logs will be evaluated to confirm or refine the conceptual geologic model of the site. Physical properties measured in the high-volume liquid waste disposal site will be compared with the 100 Area site wide data collected in the groundwater operable units.

If the data fall within an acceptable confidence interval, this will indicate that the 100 Area-wide data can be used to represent the physical properties of the waste sites for solute fate and transport analysis. Geophysical logs will be compared with data from soil sampling and will serve to fill in data gaps between sampling locations. The data collected from the vadose zone investigation will be used in conjunction with data collected from other tasks for completing the quantitative risk assessment and selecting a final remedy for the operable unit. A description of data evaluation for all tasks is provided in Section 5.1.1.10.

5.1.1.6 Task 6 - Groundwater Investigation. The groundwater investigation is being performed as part of the 100-HR-3 Operable Unit RFI, and is described in that work plan (DOE-RL 1992a).

5.1.1.7 Task 7 - Air Investigation. Although the proposed 100-DR-2 field sampling activities include actions that may expose waste and potentially contaminated soil to the atmosphere, it is anticipated that there will be minimal disturbance of significant volumes of contaminated materials during these activities. Because air is not anticipated to be a significant contaminant transport medium for the 100-DR-2 Source Operable Unit, no field activities other than routine health and safety air monitoring are planned for the air investigations (see HSP Appendix B). If the need for additional air investigation becomes apparent, however, during the course of the project or because of experience at other projects, additional air investigations will be performed as required.

5.1.1.8 Task 8 - Ecological Investigation. The ecological investigation determines the potential biocontamination transport pathways through the environment, the critical habitat for major species, and conceptual models of human and environmental risk. The ecological investigation provides information necessary to complete the risk assessment and conduct a CMS which will evaluate remedial alternatives. These tasks were performed as part of the 100 Area aggregate investigation in accordance with the activities addressed in Appendix D-2, Ecological Investigation, of the 100-HR-3 Operable Unit Work Plan (DOE-RL 1992a). Aquatic sampling was performed on the 100-HR-3 and the 100-NR-2 Operable Units to determine if further testing is necessary for the other operable units of the 100 Area.

5.1.1.9 Task 9 - Other Tasks. This task has been reserved in the event that additional tasks are identified during the course of the project. Currently, one subtask has been identified: Subtask 9a - Cultural Resource Investigation.

5.1.1.9.1 Subtask 9a - Cultural Resource Investigation. The cultural resource investigation will deal with the entire 100 Area and the 600 Area north of the Gable Mountain and south of the Columbia River, rather than individual operable units. Details of this investigation are presented in Appendix D-3, Cultural Resource Investigation, of the 100-HR-3 Groundwater Operable Unit Work Plan (DOE-RL 1992a). The task will include review of available existing data on historic land uses by local Indian tribes as well as early 20th century land use by pioneer farmers and settlers. A field survey will be conducted by a qualified archaeologist following the review of existing data.

5.1.1.10 Task 10 - Data Evaluation. Data generated during these tasks will be integrated and evaluated, coordinated with CMS activities, and presented in an ongoing manner to allow decisions to be made regarding any necessary rescoping during the course of the project. The results of these evaluations will be made available to project management personnel to keep project staff informed of progress being made. The interpretations developed under this task will be used in Task 11 - Risk Assessment, which will evaluate the overall risk to human health and the environment posed by the 100-DR-2 Operable Unit.

5.1.1.11 Task 11 - Risk Assessment. Both qualitative and baseline risk assessments will be conducted during the course of the RI/FS (RFI/CMS) process for the 100 Area. A QRA based on available site data will be used to support IRM decisions following the initial data evaluation and LFI. Baseline risk assessments will be conducted after evaluation of data from ERA, IRM, and LFI paths, the corrective measures and FS, and when necessary, the completion of additional field investigations.

The 100-DR-2 Operable Unit risk assessment process will determine the magnitude and probability of potential harm to human health and the environment by the threatened or actual release of hazardous substances from the 100-DR-2 Operable Unit in the absence of an action-oriented corrective measure. Both the qualitative and baseline risk assessments will be developed in accordance with HSBRAM (DOE-RL 1993b). This methodology addresses both human health and environmental risk assessments in accordance with appropriate federal and state guidance, including the Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual, Part A (EPA 1989a), Risk Assessment Guidance for Superfund, Volume II: Environmental Evaluation manual (EPA 1989b), EPA-Region 10, *Supplemental Risk Assessment Guidance for Superfund* (EPA 1991b), and Model Toxics Control Act Cleanup Regulations (MTCACR) (WAC 173-340). Only an overview of the risk assessment process is presented here; refer to the HSBRAM (DOE-RL 1993b) for additional information.

The risk assessment task will be divided into two subtasks:

- Subtask 11a - Human Health Evaluation
- Subtask 11b - Environmental Evaluation.

The subtasks are more fully described in the 100-DR-1 Work Plan (DOE-RL 1992b).

5.1.1.12 Task 12 - Verification of Contaminant- and Location- Specific CAR. The formulation of operable-unit-specific CAR is an ongoing process throughout the RFI/CMS. Preliminary CAR were identified and discussed in Section 3.2. Potential ARAR for the 100 Area have been developed. Following the evaluation of analytical data under Task 10, contaminant-specific and location-specific CAR will be reviewed and identified, based upon the new knowledge of contamination at the site and the site setting. Once the potential CAR for the 100-DR-2 Operable Unit have been properly identified, EPA and Ecology will be asked to verify the contaminant- and location-specific CAR. Project staff will work with the regulatory agencies, taking operable unit-specific conditions into account, and will decide which promulgated environmental standards, requirements, criteria, and limitations are actually applicable or relevant and appropriate to the 100-DR-2 Operable Unit.

5.1.1.13 Task 13 - Limited Field Investigation Report. An interim report will be prepared upon completion of the LFI. This report will consist of a preliminary summary of the characterization activities described in Tasks 1 through 12. Information pertinent to the operable unit conceptual model will be refined, as necessary. The report will include the results of the historical investigation, identify the contaminant- and location-specific CAR, and provide an assessment of whether contaminant concentrations pose an unacceptable risk that warrants action through an IRM.

5.1.1.14 Task 14 - Natural Resource Damage Assessment. For RCRA corrective action units, the trigger for NRDA is the discharge or release of a hazardous substance. Potential injury from past releases will need to be identified. Potential future injuries, as a result of corrective actions, will need to be considered in the context of NRDA. The NRDA considerations are important prior to establishing the ecological corrective action objectives.

5.1.2 Final RCRA Facility Investigation

The final RFI provides any additional data and characterization needed to support selection, design and implementation of a final corrective action for the operable unit. The final RFI is performed at remaining low-priority sites where existing data are considered insufficient by the unit managers, and at any remaining high-priority sites where final cleanup criteria and/or existing data are considered insufficient by the unit managers, and at any remaining high-priority sites where final cleanup criteria were not achieved during the IRM. The final RFI may consist of data compilation, nonintrusive investigations, intrusive investigations, and data evaluation. Analyses conducted during the final RFI will use data collected during the LFI, during IRM implementation, and in previous investigations.

A baseline risk assessment is performed as part of the final RFI. This assessment provides a quantitative evaluation of residual risk at the operable unit after completion of the IRM, and is conducted according to HSBRAM (DOE-RL 1993b). The results of this assessment are used to help determine the need for corrective actions, to select the corrective action, and to determine risk-based cleanup levels for the corrective action.

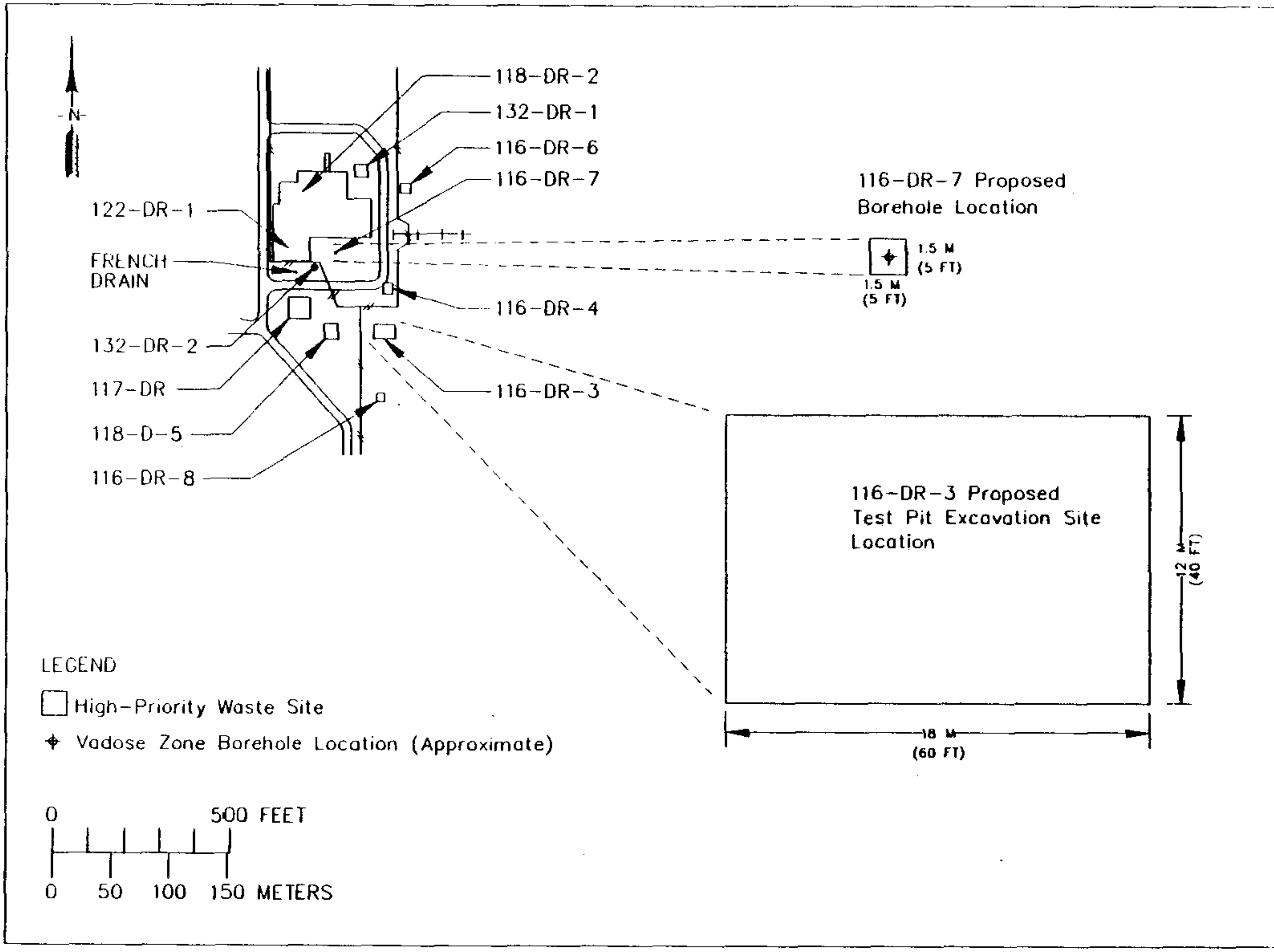
The final RFI is conducted in parallel with the final CMS, permitting the collection of any additional data that may be identified when conducting the final CMS. The final RFI and the baseline risk assessment are documented in the final RFI report, which is a secondary document.

5.2 CORRECTIVE MEASURES STUDY PROCESS

In accordance with the *Hanford Federal Facility Agreement and Consent Order Change Packages* (Ecology et al. 1991), the FS and CMS process for the 100 Area will be conducted on both an aggregate area and operable unit basis. The EPA published Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA 1988a) will be used as the guidance document for the content and approach to each of the feasibility and corrective measures studies performed. This process includes preparation of a 100 Area FS completed on an aggregate area basis, a focused FS, and a final CMS completed on an operable unit basis. The IRM process takes place between the focused FS and final CMS. A description of the IRM process and each of the corrective measures and FS is provided in the 100-DR-1 Work Plan (DOE-RL 1992b). The emphasis in this work plan is placed on the focused FS. If a final CMS is necessary, the tasks outlined for the focused FS would be repeated. This process is intended to reduce the level of effort required for any one individual study and allow initiation of corrective action activities based on known data and previously tested/demonstrated technologies.

THIS PAGE INTENTIONALLY
LEFT BLANK

9413296.1730

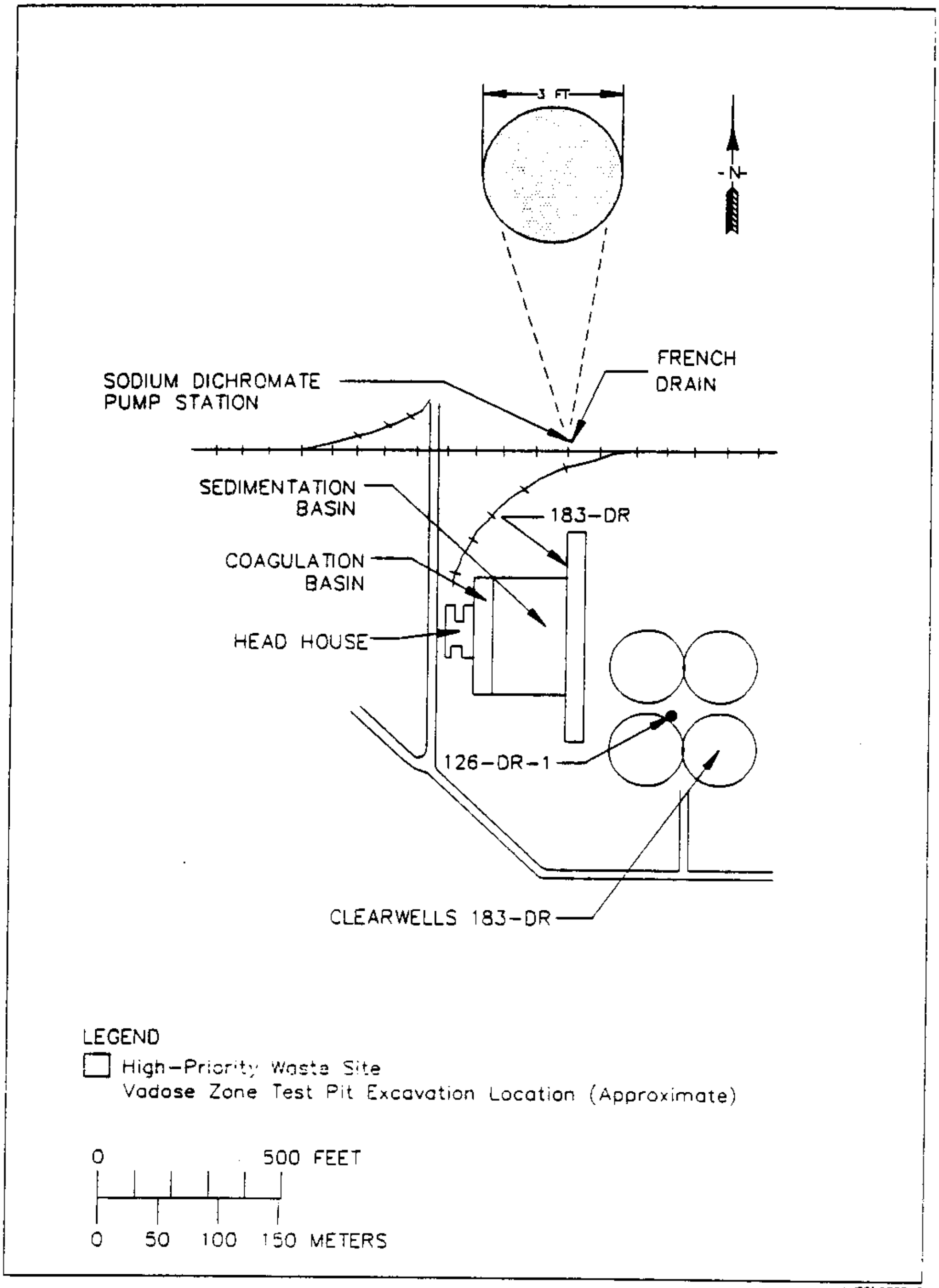


LYSO\DR2-BORE

Figure 5-1 High-Priority Liquid Waste Facility

THIS PAGE INTENTIONALLY
LEFT BLANK

Figure 5-2 Sodium Dichromate French Drain



THIS PAGE INTENTIONALLY LEFT BLANK

Table 5-1 100-DR-2 Operable Unit Vadose Zone Investigation

Location	Number of Boreholes/ Test Pit	Number of Samples	Types of Analyses				
			TAL	TCL[a]	RAD	Physical	Cr^{6+}
116-DR-3 Storage Basin Trench	1	2	X	X	X		X
116-DR-7 Inkwell Crib	1	8	X	X	X	X	X
Sodium Dichromate/ Acid Tanker Car Off Loading Facility	1	2	X	X	X		X

[a]= If field screening results indicate the presence of VOCs, samples will be collected and submitted for TCL analyses.
TAL= Target Analyte List
TCL= Target Compound List
RAD= Radionuclides

9413295.1732

THIS PAGE INTENTIONALLY
LEFT BLANK

6.0 SCHEDULE

An operable unit schedule, which supports the Tri-Party Agreement Action Plan work schedule (Ecology et al. 1990a), has been prepared detailing the work described in Chapter 5 of this work plan. This schedule (Figure 6-1) is the baseline that will be used to measure progress in implementing this work plan. The approval of this work plan is for the work associated with the 100-DR-2 Operable Unit and is not binding for any other work plan.

The integrated schedule, the operable unit schedule, and the 100 Area-wide activity schedule are incorporated by reference. They include interim milestones established to track and help ensure progress of the various tasks. A formal change control process has been established in the Tri-Party Agreement Action Plan, and will be used, if necessary, to modify milestones shown in the schedules.

THIS PAGE INTENTIONALLY
LEFT BLANK

Figure 6-1 100-DR-2 Operable Unit Schedule

THIS PAGE INTENTIONALLY
LEFT BLANK

7.0 PROJECT MANAGEMENT

This chapter defines the administrative and institutional tasks necessary to support the RFI/CMS for the 100-DR-2 Operable Unit at the Hanford Site. Also, this chapter defines the responsibilities of the various participants, the organizational structure, and the project tracking and reporting procedures. This chapter is in accordance with the provisions of the Tri-Party Agreement Action Plan dated August 1990. Any revisions to the Tri-Party Agreement Action Plan that would result in changes to the project management requirements would supersede the provisions of this chapter.

The project management activities included in the 100-DR-1 Work Plan (DOE-RL 1992b) cover all of the activities which are part of the 100-DR-2 Work Plan. Therefore, the 100-DR-1 Work Plan (DOE-RL 1992b), Chapter 7.0 *Project Management* shall be used for 100-DR-2, by reference.

THIS PAGE INTENTIONALLY
LEFT BLANK

8.0 REFERENCES

CDM Federal Programs Corporation, 1987, *Data Quality Objectives for Remedial Response Activities: Volume 1, Development Process*, EPA-540/G-87/003A, U.S. Environmental Protection Agency, Office of Emergency and Remedial Response and Office of Solid Waste and Emergency Response, Washington, D.C.

Clukey, H.V., 1954, *Tabulation of Radioactive Liquid Waste Disposal Facilities*, HW-33305, General Electric Company, Richland, Washington.

Delaney, C.D., 1991, *Geology and Hydrology of the Hanford Site: A Standardized Text for Use in Westinghouse Hanford Company Documents and Reports*, WHC-SD-ER-TI-0003, Westinghouse Hanford Company, Richland, Washington.

DOE, 1987a, *Final Environmental Impact Statement - Disposal of Hanford Defense High-Level, Transuranic, and Tank Wastes*, DOE/EIS-0113, Volumes 1 through 5, U.S. Department of Energy, Washington, D.C.

DOE, 1988a, *Site Characterization Plan, Reference Repository Location, Hanford Site, Washington; Consultation Draft*, DOE/RW-0164, U.S. Department of Energy, Office of Civilian Radioactive Waste Management, Washington, D.C.

DOE-RL, 1989, *Environmental Restoration Field Office Management Plan*, DOE/RL-89-29, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1991a, *Hanford Past-Practice Strategy*, DOE/RL-91-40, Draft A, U.S. Department of Energy, Washington, D.C.

DOE-RL, 1991b, *Hanford Site Waste Information Data System*, data file accessed June 16, 1991, U.S. Department of Energy, Richland Operations Office, Richland, Washington

DOE-RL, 1992a, *RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-HR-3 Operable Unit, Hanford Site, Richland, Washington*, DOE/RL 88-36, Draft D, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1992b, *RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-DR-1 Operable Unit, Hanford Site, Richland, Washington*, DOE/RL 89-09, Draft C, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1992c, *RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-HR-1 Operable Unit, Hanford Site, Richland, Washington,* DOE/RL 88-35, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1992d, *100 Area Feasibility Study, Phases 1 and 2*, DOE/RL-92-11, Volume 1, U.S. Department of Energy, Richland, Washington.

DOE-RL, 1993a, *Limited Field Investigation Report for the 100-DR-1 Operable Unit,* Draft A, DOE/RL-93-29, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1993b, *Hanford Site Baseline Risk Assessment Methodology,* Rev. 2, DOE/RL-9-1-45, U.S. Department of Energy, Richland, Washington.

DOE-RL, 1993c, *Hanford Site Background: Part 1 Soil Background for Nonradioactive Analytes*, DOE/RL-92-24, Rev. 1, Draft, U.S. Department of Energy, Richland, Washington.

Dorian, J.J., and V.R. Richards, 1978, *Radiological Characterization of the Retired 100 Areas,* UNI-946, United Nuclear Industries, Richland, Washington.

Ecology, EPA, and DOE-RL, 1990a, *Hanford Federal Facility Agreement and Consent Order*, First Amendment, Two volumes, 89-10 Rev.1, Washington Department of Ecology, Olympia, Washington, U.S. Environmental Protection Agency, Region X, Seattle, Washington, and U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, EPA, and DOE-RL, 1990b, *Community Relations Plan for the Hanford Federal Facility Agreement and Consent Order,* Washington Department of Ecology, Olympia, Washington, U.S. Environmental Protection Agency, Region X, Seattle Washington, and U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, EPA, and DOE-RL, 1991, *Hanford Federal Facility Agreement and Consent Order Change Packages,* May 16, 1991, Washington State Department of Ecology, Olympia, Washington, U.S. Environmental Protection Agency, Region X, Seattle, Washington, and U.S. Department of Energy, Richland Operations Office, Richland, Washington.

EPA, 1986, *Quality Criteria for Water 1986,* EPA/440/4-86-001, U.S. Environmental Protection Agency, Office of Water Regulations and Standards, Washington, D.C.

EPA, 1988a, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA; Interim Final,* EPA-540/G-89/004, U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington D.C.

EPA, 1988b, *Superfund Exposure Assessment Manual*, EPA-540/1-88/001, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1989a, *Risk Assessment Guidance for Superfund: Volume 1, Human Health Evaluation Manual; Interim Final*, EPA/540/1-89/002, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1989b, *Risk Assessment Guidance for Superfund: Volume II, Environmental Evaluation Manual; Interim Final*, EPA/540/1-89/001, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1991a, *Integrated Risk Information System (IRIS) Database*, U.S. Environmental Protection Agency, accessed through National Library of Medicine Toxicology Data Network (TOXNET), Bethesda, Maryland.

EPA, 1991b, *Supplemental Risk Assessment Guidance for Superfund*, U.S. Environmental Protection Agency, Region X, Seattle, Washington.

General Electric, 1963, *Hazards Summary Report: Volume 3 - Description of the 100-B, 100-C, 100-D, 100-DR, 100-F and 100-H Production Reactor Plants*, HW-74094, General Electric, Hanford Atomic Products Operation, Richland, Washington.

Heid, K.R., 1956, *Unconfined Underground Radioactive Waste and Contamination -- 100 Areas*, HW-46715, General Electric, Hanford Atomic Products Operation, Richland, Washington.

Jaquish, R.E., and P.J. Mitchell (editors), 1988, *Environmental Monitoring at Hanford for 1987*, PNL-6464, Pacific Northwest Laboratory, Richland, Washington.

Jaquish, R.E., and R.W. Bryce (editors), 1990, *Hanford Site Environmental Report for Calendar Year 1989*, PNL-7346, Pacific Northwest Laboratory, Richland, Washington.

Kiser, S.K., 1988, *Hanford Surplus Facilities Programs Facilities Listings and Description*, WHC-SP-0331, Westinghouse Hanford Company, Richland, Washington.

Lindsey, K.A., 1991, *Revised Stratigraphy for the Ringold Formation, Hanford Site, South Central Washington*, WHC-SD-EN-EE-004, Westinghouse Hanford Company, Richland, Washington.

Miller, R.L., and J.M. Steffes, 1986, *Fuel Storage Basins Cleanup and Stabilization Project Report*, UNI-3958, United Nuclear Industries, Richland, Washington.

Miller, R.L., and R.K. Wahlen, 1987, *Estimates of Solid Waste Burial in 100 Area Burial Grounds*, WHC-EP-0087, Westinghouse Hanford Company, Richland, Washington.

Myers, C.W., S.M. Price, J.A. Caggiano, M. P. Cochran, W.H. Czimer, N.J. Davidson, R.C. Edwards, K.R. Fecht, G.E. Holmes, M.G. Jones, J.R. Kunk, R.D. Landon, R.K. Legerwood, J.T. Lillie, P.E. Long, T.H. Mitchell, E.H. Price, S.P. Reidel, and A.M. Tallman, 1979, *Geologic Studies of the Columbia Plateau: A Status Report*, RHO-BWI-ST-4, Rockwell Hanford Operations, Richland, Washington.

Owen, F.E., 1967, *Radiological Guide to Deactivation of D-DR Production Facilities*, DUN-2477, Douglas United Nuclear Inc., Richland, Washington.

Peterle, T.J., 1991, *Wildlife Toxicology*, Van Nostrand Reinhold, New York, New York.

PNL, 1991, *Resource Book-Decommisioning of Contaminated Facilities at Hanford*, PNL-7008, vols. 1-3, Pacific Northwest Laboratory, Richland, Washington.

Stanley, T.W. and S.S Verner, 1983, *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans*, EPA/600/4-83/004, U.S. Environmental Protection Agency, Office of Exploratory Research, Washington, D.C.

Stenner, R.D.,.K.H. Cramer, K.A. Higley, S.J. Jette, D.A. Lamar, T.J. Mclaughlin, D.R. Sherwood, and N.E. Van Houten, 1988, *Hazard Ranking System Evaluation of CERCLA Inactive Waste Sites at Hanford*, PNL-6456, Pacific Northwest Laboratory, Richland, Washington.

Stone, W.A., J.M. Thorpe, O.P. Gifford, and D.J. Hoitink, 1983, *Climatological Summary for the Hanford Area*, PNL-4622, Pacific Northwest Laboratory, Richland, Washington.

WHC, 1988, *Environmental Investigations and Site Characterization Manual*, WHC-CM-7-7, Westinghouse Hanford Company, Richland, Washington.

WHC, 1991a, *WIDS Database Field Descriptions and Data*, WHC-MR-0056, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

WHC, 1991b, *Environmental Compliance Manual*, WHC-CM-7-5, Westinghouse Hanford Company, Richland, Washington.

WHC, 1993, *100-D Area Technical Baseline Report*, WHC-SD-EN-TI-181, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Winship, R.A., 1965, *DR-Plant Radiation Zones Final Status Report*, RL-REA-1071.

Appendix A

Quality Assurance Project Plan

THIS PAGE INTENTIONALLY
LEFT BLANK

Appendix B

Health and Safety Plan

THIS PAGE INTENTIONALLY
LEFT BLANK

Appendix C

100-DR-1 Radiological Surveys

THIS PAGE INTENTIONALLY
LEFT BLANK

ATTACHMENT 1

METRIC CONVERSION CHART

THIS PAGE INTENTIONALLY
LEFT BLANK